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STEAMSHIP MODELS

BOOKS ON THE SEA BY
E. KEBLE CHATTERTON

HISTORICAL

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SHIPS AND WAYS OF OTHER DAYS
FORE AND AFT: THE STORY OF THE FORE AND AFT RIG
STEAMSHIPS AND THEIR STORY
THE ROMANCE OF THE SHIP
THE STORY OF THE BRITISH NAVY
KING'S CUTTERS AND SMUGGLERS
THE ROMANCE OF PIRACY
THE OLD EAST INDIAMEN
Q-SHIPS AND THEIR STORY
THE MERCANTILE MARINE
THE ROMANCE OF SEA ROVERS
THE AUXILIARY PATROL
SHIP-MODELS
SEAMEN ALL

CRUISES

DOWN CHANNEL IN THE "VIVETTE"
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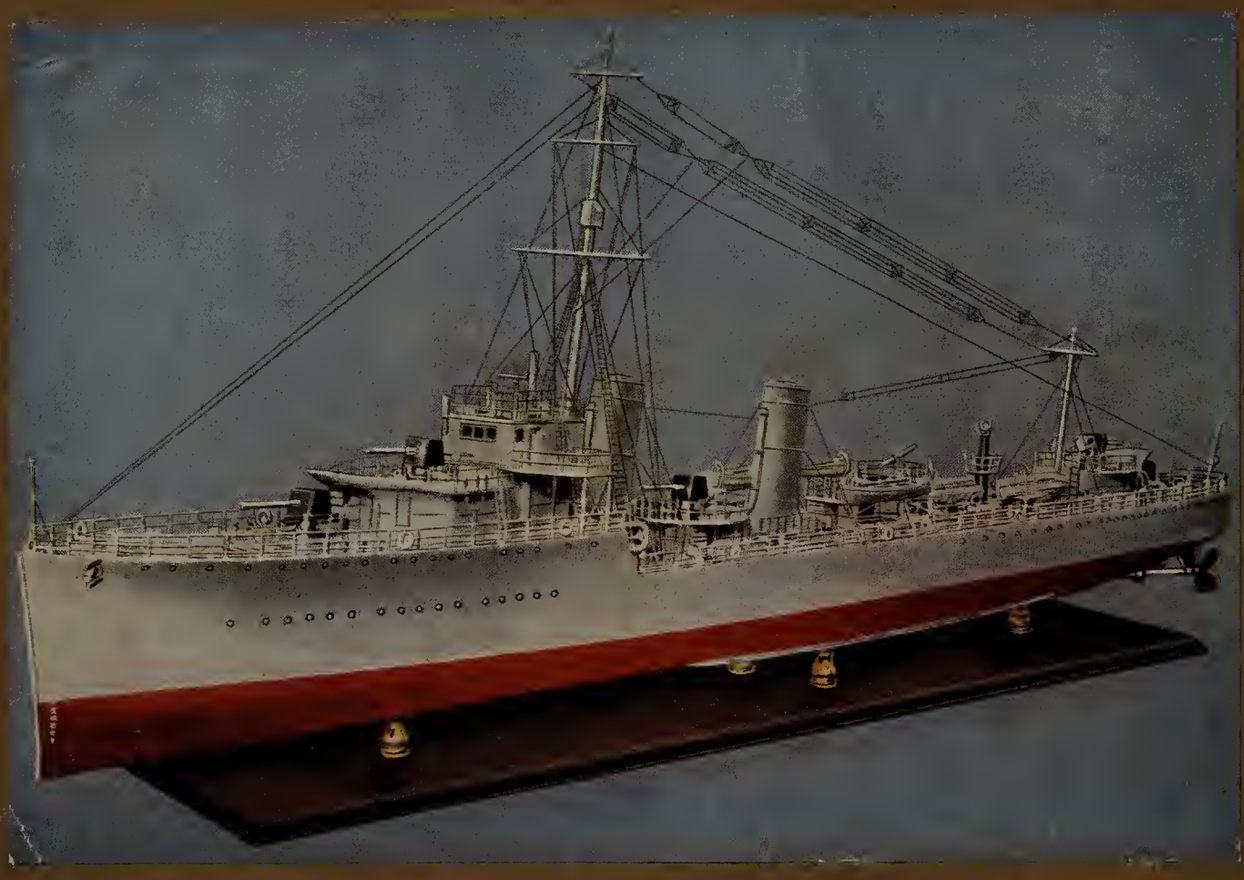


PLATE 1

H.M.S. " SPENSER " (1917)
1750 tons displacement, 329 feet long, speed 36 knots.
(*Messrs John I. Thornycroft & Co. Ltd.*)

STEAMSHIP MODELS

BY E. KEBLE CHATTERTON

WITH ONE HUNDRED AND TWENTY-EIGHT
PLATES IN COLOUR AND HALF-TONE



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PREFACE

THE story of the steamship is concerned primarily with Great Britain, for the reason (as will be seen in the following pages) that this country, more than any other, has been responsible for its initation and development. It is only to be expected, therefore, that most of the best models illustrating the subject are British. At the same time I have availed myself of examples from other nationalities where requisite.

I am greatly indebted to both public and private collections, to ship-owners, ship-builders, and naval architects for permission to reproduce these fascinating models, and especially I desire to acknowledge the courtesy of the following :—The Board of Education and Science Museum, South Kensington; the Royal Naval Museum, Greenwich; the Imperial War Museum; the Curator of the United States Naval Academy, Annapolis; the Smithsonian Institution, United States National Museum; Messrs the Peninsular & Oriental Steam Navigation Company ; the Cunard Steam Ship Company Ltd.; the White Star Line; Palmers Shipbuilding & Iron Co. Ltd.; the Fairfield Shipbuilding & Engineering Company, Ltd.; Sir W. G. Armstrong, Whitworth & Co. Ltd.; John I. Thornycroft & Co. Ltd.; Yarrow & Co. Ltd.; J. Samuel White & Company Ltd.; Harland & Wolff Ltd.; William Beardmore & Co. Ltd.; Smith's Dock Company; G. L. Watson & Co.; The Union-Castle Mail Steamship Company Limited; The Orient Line; The Royal Mail Steam Packet Company; London Midland and Scottish Railway

Company; Southern Railway; William Denny and Brothers Ltd.; Barclay, Curle & Company Ltd.; The Shell Transport and Trading Company Ltd.

Now that sailing ships are all but banished from the Mercantile Marine, steamships are the expression of sea power; and even a cursory glance of the models here included will shew a fair idea of the types of vessels which in our own time carry on maritime trade or protect it on its far flung routes.

E. KEBLE CHATTERTON.

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STEAMSHIP MODELS

IN my recent volume on sailing ship models, which went immediately out of print, I endeavoured to trace the progress of the sailing ship to the present day. The hope was put forward in the press and by others that " a companion volume will be forthcoming, to hand down to posterity the no less interesting, if less picturesque, history of the development of the steamship as portrayed in ship models."

The present book, therefore, represents an attempt to carry out that ambition, and in this year of the great British Empire Exhibition the time is particularly appropriate. It is just a hundred years ago since the first steam-driven ship put to sea, and in no century of the entire maritime history of the world has so much been accomplished or have so many amazing and revolutionary developments taken place. Events have followed close on each other with such rapidity that they have swept by without our being able to realise their profound importance. The steamships to-day of the navies and mercantile marines are so familiar to our eyes that even a ten-year-old vessel, and certainly one just twice that age, seems to us old-fashioned. There are still alive officers and men who never served except in sailing craft, but very shortly they will all be dead.

Contrariwise, there are precious few officers and men to-day serving in steam who ever went to sea in sail. We all know that the ocean-going sailing ships, and therefore their crews, have been getting

fewer and fewer ever since the middle of the last century. We remember, too, that during the war these craft were at the mercy of the enemy and compelled to pay a heavy toll. But we do not forget that the history of the British nation and empire has been founded on the sail-propelled vessel certainly up to about fifty years ago. And that being so, you will perhaps be startled when you learn that in 1923 large numbers of mercantile ocean-going sailing ships were sold to be broken up so that only *five* British craft remained in employment. Of these iron and steel ships still employed there are not more than 125 in the whole world, eight being French, eight Italian, twenty-five German, five Danish, four Swedish, twenty-five Finnish and forty-five Norwegian.

Five British ocean-going sailing ships! A hundred years ago there were squadrons of East Indiamen and a whole fleet of sailing men-of-war under the British flag; less than sixty years ago the tea-clippers were the fastest craft afloat. Yes; it seems incredible that all this change has happened so quickly, and that already we are fully accustomed to the 50,000-ton steam ship with ballroom, swimming bath and every conceivable luxury. And it is because the steam ship is altering so quickly, because the motor vessel and the airship will before long exercise yet another devastating influence, that the time has come to peg down knowledge whilst we may. One of the pioneer firms of steam shipping informed me the other day that during the war they were so pressed for office space that they actually destroyed some of their ship models. Presently, elsewhere, you may find other models being treated in the same way or allowed to fall to pieces in some lumber room. A hundred years hence these models will be inestimable, they will be regarded by the collector and ship enthusiast with envy.

Thus in these pages I have endeavoured to present an historical

and pictorial record whilst the models are still in existence, and to give the reader not a treatise on steam propulsion nor on marine engineering, but I have sought rather to shew how the ship herself has been developed and the reasons. When all the coal and oil fuel have been used up, perhaps owners will be only too thankful that the wind still exists to drive a ship. Then may come the day of the sailing ship again after its temporary eclipse. But in our survey of the last hundred years we are fortunate in being able to find models of practically every important development in ship types. Scarcely one is missing from our series, and then only because such a model does not exist or for some special reason is unavailable.

It is hoped that in regarding these fascinating models of steam craft the reader will feel by reaction some pride in the accomplishment of his forefathers and contemporaries in their courage as well as their skill. For, look at it how you will, the creation of the mammoth liner or the leviathan battleship is a stupendous affair, and it is only because we are living so near to things that we are quite incapable of appreciating the right values. I trust that no one, after watching the consecutive models in this volume, will dare to suggest that the steamer's evolution is any whit less romantic than that of the sailer. To us in this twentieth century no craft seem more romantic than the Elizabethan ships, but the Sixteenth century seamen thought otherwise. These Tudor ships were unhandy and unhealthy, they were clumsy in design, and their crews during long voyages died like flies. It is only because these craft are so different from our ships of to-day that they seem so fascinating to us. Truro or Liverpool Cathedral is a beautiful architectural design, an Elizabethian ship was hardly that; yet we admire the latter more than the former because of the distant glamour which attaches to the period of Drake. The lines of the " Victory " are not to be compared with the sweet sym-

metry of a modern battle-cruiser, yet it is the association of Nelson's gallantry that makes us think much more highly of the older ship.

Romance is largely made up of a distant gulf. Because something is gone and passed, we begin to imagine it out of its true proportion; we endow it with a halo of our own manufacture. We think of the famous clipper "Cutty Sark" almost reverentially, even though she is still afloat; yet men who sailed in her said she was a brute in a seaway. Presently we shall look at the picture of the first Cunarder "Britannia." Rightly we regard this model as one of the most valuable nautical possessions in England, because the ship she represents was so historic, so fascinatingly interesting. Charles Dickens, however, thought differently. He crossed in her to America in 1842, and the adjectives he used in describing this vessel's accommodation were "utterly impracticable, thoroughly hopeless, and profoundly preposterous."

Thus, the time will come when some day the models of even the newest contemporary ships at the end of this book will appear full of romance, and we must not be blinded by the fact that time alters our entire outlook on ships as well as crinolines. We are about to witness the mind of man seeking to express itself in the creation of ships that have to include problems which never assailed the naval architect of the sailing ships from the prehistoric days till the coming of the nineteenth century. We shall see the wooden hull gradually give way to iron, iron to steel, auxiliary engines gradually sweeping away canvas and becoming supreme. We shall witness the single propeller becoming replaced by the quadruple screws, turbines and oil-fuel taking the place of reciprocating engines and coal. The warship gets clean away from any influence of the wooden-wall period, in spite of the most violent prejudice; and armour plates and big guns make the Nelsonian era further away than it really is. It is all so

momentous historically, so important practically, so full of human interest that which of us would ever dare to say this story of the steamship was not romantic?

It is a curious fact that just at the time when the steamship was becoming thoroughly efficient and reliable, the sailing ship was reaching the height of her development and about to become obsolete. But it is a natural characteristic of human nature to proceed along the easiest way. Just as the primitive man soon got tired of punting or paddling his canoe and harnessed the wind, so eventually it was inevitable that some other means must be sought to enable the ship to travel independently of the breeze. The idea of the mechanically-driven craft is far older than that of the steamship. Without wearying the reader we may illustrate this statement by going back as far as B.C. 264 when Appius Claudius Caudex transported his troops across the Messina Straits in boats moved by paddle wheels which were revolved by oxen turning capstans. In that sixteenth century which did so much for the sailing ship this idea was revived by Blasco de Garray, who in the year 1543 experimented at Barcelona with a vessel of 109 tons and later with even another ship. A great deal of inaccurate surmise has been made, but we do know definitely that one ship had a paddle wheel on either side actuated by twenty-five men, and the other ship needed forty men; and that a speed of $3\frac{1}{2}$ English miles an hour was obtained. It was found, however, that for any distance the use of oars was preferable. There is nothing improbable about this experiment; it shews the existing idea and desire to improve on sail, and we may mention that as recently as 1859 when the 48-ton tug "Lyttelton" was being *sailed* out from the Thames to New Zealand and was becalmed near the equator, her enterprising Scotch engineer rigged up an old foremast as an axle, fixed up a primitive paddle-wheel arrangement on either side, con-

structed hand-gear worked by the crew from deck, and for several weeks, whenever the wind was light, the "Lyttelton" (whose own paddle-wheels had been unshipped before sailing and stowed in the forehold) was able to do about a mile an hour.

In Elizabethian literature you find William Bourne, for instance, publishing a theory for making "a Boate to goe without oares or Sayle, by the placing of certaine wheels on the outside of the Boate." Other instances could be given to shew that the idea of the paddle wheel as a means of ship propulsion is very old and lingered persistently in men's minds. But the power, be it noted, was obtained either from beasts or from human labour which was then cheap, seeing that prisoners and slaves were used by the score to row Mediterranean galleys. We are getting much nearer to our subject as we come to the year 1690 when Denis Papin, a French engineer, but an exile at the Court of the Landgrave of Hesse, published a suggestion for obtaining power by means of steam and set his mind to employing this to *rowing* craft against the wind.

It was in 1707 that he actually constructed the first steamboat, which was navigated on the river Fulda in Hanover, but on arriving at Munden the local watermen were so annoyed that they smashed this new contraption to pieces and Papin fled for his life. Be it noted that Papin is the real father of the steamship but his method was the use of rotatory oars. The progress now continues. Thomas Newcomen of Dartmouth developed the idea in that he invented an engine which was the precursor of the reciprocating steam engine, but in 1736 we find Jonathan Hulls patenting a steam tug—"a New-Invented Machine for Carrying Vessels or Ships out of or into any harbour, port or river, against wind and tide or in a calm." He was the adapter of Newcomen's atmospherical engine to marine purposes, and we know that he at least experimented with such a vessel (the

paddle wheel being at the stern of the craft) on the River Avon in 1737.

The eighteenth century, therefore, was wrestling keenly with this problem of propelling ships mechanically, and various theories and experiments were being put forward in Europe. It happened that in 1775 there was on view in Paris an engine which had been made by the famous James Watt, which aroused so much interest that a boat was hired on the Seine and a Watt engine of one-horse power was installed. The result, however, was a failure owing to the strength of the river current, yet it was to have important results indirectly, for the Marquis de Jouffroy had been interested in Watt's engine, obtained one for his 13-metre boat, but nothing of importance resulted. In 1781 he built a steam craft 46 metres long, 5 metres wide, draught 1 metre, and in the presence of thousands of spectators she went against the stream from Lyons to the Isle of Barbe two years later.

The important fact is that this comparatively big craft was propelled by steam and side paddle wheels. The Marquis' experiments were ended six years later owing to the French Rvolution; and after he returned from exile and before he was able to obtain a patent for his invention, he had been forestalled. But right down to the year 1787 the ancient idea of propelling a ship's paddle wheels by means of physical labour continued. Patrick Miller, a rich Edinburgh banker, experimented with a double-hulled ship built at Leith, five paddle wheels seven feet in diameter being placed btween the two hulls and driven by thirty men revolving the capstan. This was a 255-ton ship and a speed of $4\frac{1}{2}$ knots was obtained. But when it was suggested to Miller that steam power would revolve the paddle wheels better, William Symington was commissioned to design a suitable engine; so this was fitted to a 25 ft. double-hulled craft which was tried on

Dalswinton Loch and eventually a speed of seven knots was obtained. This was in 1788, and in the following year Miller had a similar experiment made on the Forth and Clyde Canal with a steam craft that towed a heavy load at seven miles an hour.

With this brief introduction we are now ready to examine our models one by one, and to see how the influence of steam has changed the ship's character. Briefly, then, throughout all the centuries that we have been discussing, the ingenious minds had been working not on the screw but the paddle wheel, and it was not till the steam engine became a real thing that the mechanical ship could have any chance. The eighteenth century provided that essential; for Newcomen was largely instrumental in making the piston engine a practical machine, then James Watt developed this idea, and Symington applied the notion to ship propulsion.

Thus the first of our models in this pictorial record is that of the famous "Charlotte Dundas," which was the first steam craft beyond the mere experimental stage. She was built in 1801 at Grangemouth and was intended for a tug on the Forth and Clyde canal. She measured 56 ft. long, beam 18 ft., depth 8 ft. The machinery was made by Symington and consisted of a Watt double-acting, condensing engine placed horizontally and acting directly, by means of a connecting rod, on the crank of a shaft which drove a single paddle-wheel not at the sides but at the stern. For this wheel a recess was left four feet wide, and at the double stern were twin rudders. The engine was of 10 nominal horse power, and was the first horizontal direct-acting engine ever made in Britain.

In the illustration the paddle-wheel is left open, the circular hood has been removed and is seen at the left-hand side, but in practice this covered the wheel to keep off the spray. This ship towed two loaded vessels, of 70 tons each, nineteen and a half miles next year

on the canal, but the owners of the canal decided that the damage caused to the banks would be too serious to allow the use of steam tugs, and so she was laid up in a creek, allowed to fall into decay until in 1861 when she was broken up. She had been built for Lord Dundas and will always be historic, for from her you can trace all the paddle tugs, the first Atlantic liners, the modern excursion steamers, and those stern - wheel, light - draught vessels which are essential to transportation in Nigeria and elsewhere.

In America that wonderful nineteenth century was to open up the steamship era there also, the last connection with mediaevalism in regard to shipping was beginning to be severed all the world over, progress which had been so slow was now to be allowed its chance, and the time had come to make mechanical ship propulsion a real, practical thing. Thus in 1804 John Stevens constructed a steamboat which crossed the Hudson to New York Battery from Hoboken. In this craft the propulsion was at the stern, steam was generated in tubular boilers—the first of their kind to be made—but in this pioneer craft the paddle-wheel was not used, a double screw with four blades being employed. This was not a long run, but three years later came Robert Fulton's "Clermont," which was 133 ft. long with 18 ft. beam, and steamed up the Hudson from New York to Albany, a distance of 150 miles in thirty-two hours. It was this achievement which finally settled any possible doubts on the future of the steamship. If a mechanically-driven craft could go all that distance, much might be expected to follow.

It should be added, however, that Fulton had had the opportunity of seeing the "Charlotte Dundas" doing her trial trip in Scotland, and the principal parts of the "Clermont's" engine had been made by Messrs Boulton & Watt and sent across the Atlantic. I have

included here a model of this celebrated ship, which has been specially sent to me from the United States National Museum, Smithsonian Institution, Washington. At the time of the Hudson-Fulton celebrations in 1909 a replica of the real " Clermont " was reconstructed down to the smallest detail and actually steamed up the Hudson river. The original ship had a paddle-wheel or " water-wheel " each side, and she was destined to give the steamboat a wonderful impetus in America; for there followed in 1808 the " Car of Neptune," and sixteen other steam vessels, including a steam frigate, before Fulton died in 1815.

The success of the " Clermont " (afterwards altered and called the " North River ") as the inaugurator of a river passenger service had its influence on the Clyde; for in 1811-1812 there was built at Port Glasgow a little steamer of about 25 tons burthen, measuring over forty feet in length. This was the " Comet," another historic ship that was to ply up and down the Clyde and was the first ship moved by steam to carry on a regular service in Europe, thirteen years before the first public steam railway had been set going. She began in August 1812 to carry passengers between Glasgow and Greenock, three more paddle steamers were then ordered to be built for the same service, but the " Comet " was afterwards sent to the Firth of Forth, but in 1818 carried on transportation between the Western Highlands and Glasgow. Two years later while on her way from Fort William she got ashore and was wrecked.

The origin of the " Comet " was on this wise. She was built for Henry Bell, who was another of those men of vision who had interested themeslves in mechanical ship propulsion. He was a friend of Fulton and of Symington; he had like various others begun his experiments with hand propulsion but soon realised that steam was the only solution. He was a plain, uneducated man, the proprietor of an hotel

and bathing establishment at Helensburgh, but he had at one time owned an engine for pumping seawater for the baths, and he had been present at the trials of the " Charlotte Dundas ". His mind was enterprising enough to imagine that the " Comet " would pay on the Clyde between Helensburgh and Glasgow, though as a fact she was financially unsuccessful there. But that is often the way with pioneers.

This model in the South Kensington Museum was made by Mr. T. Rennie from the lines of the vessel which still exist. Like the " Clermont " she was a side paddler, and thus unlike the " Charlotte Dundas." Originally the " Comet " had two radial paddles each side but one pair of wheels was substituted. She has a bow reminiscent of the contemporary frigates and East Indiamen, and the same heavy lines as to her hull. But you will observe that she is mastless—and this was surely the beginning of the great change—though the tall smoke stack was employed also for a mast. From this stack a yard was set for a square sail, and from the much shortened bowsprit a triangular headsail was also set.

The " Comet " was driven by a kind of inverted beam engine, which developed four horse power, her best speed being five knots. Steam was generated from a boiler set in brickwork. She possessed both foc'sle and after cabin, the engine room taking up the intervening space. She was advertised ready " to sail by the power of air, wind, and steam ". Her name was given to her because about that time a meteor had appeared in the heavens, and her career was meteoric enough : but her actual influence was enormous. Not only were other steamboats built for the Clyde but she caused the commencement of a steamship service between Scotland and Ireland, the " Rob Roy " being the first steam vessel to run between Greenock and Belfast in 1818. Other vessels followed : the Straits of Dover saw the advent of

steam, for the " Rob Roy " in 1820 began to run between Calais and Dover. Auxiliary power was introduced even into the sailing ships crossing the Atlantic to America or round the Cape of Good Hope to India, and in 1821 the first steamship corporation that was ever formed —the General Steam Navigation Company—began its service with the SS. " City of Edinburgh ".

It was in 1837 that the Peninsular Steam Navigation Company was founded and they began a weekly mail service to Portugal, Spain, and Gibraltar, though at first they ran only to the Peninsula without a contract for mails. The vessel which they obtained for inaugurating the service of mail packets was the wooden steamship " William Fawcett " and the reader will find a coloured illustration of this model which is in the possession of the Peninsular and Oriental Steam Navigation Company as the firm is known to-day. The " William Fawcett " was built in 1829, only seventeen years after the " Comet," and had been employed at first by her other owners on the cross-channel route to Ireland. Hence the harp device on the paddle box. This craft measured a little over 74 ft. long, about 15 ft. beam, her tonnage was a little more than two hundred and she possessed but sixty horse power. But as we examine her closely there are several points of interest. We see in her how the " Comet " was to hand down and standardise the design of the steamship for some years to come. The bowsprit and jib-boom, the yards on the foremast, the heavy stern are all in keeping with the sailing ship of the date. The " Clermont " and the " Comet " had shewn that the propulsion should be paddle-wheels placed on each side and not aft. The short t'gallant foc'sle, the long poop, where the passengers promenaded, with its open rails and netting, the figure-head and so on are all most intriguing to us who think of the modern P. & O. liners.

Besides her headsails, the " William Fawcett " set canvas on her gaffs and yards when she could get a fair wind, and as her depth was only just over eight feet this amount of canvas would have a desirable steadying effect. But we may well sympathise with the timid passengers to the Peninsula when we consider the lively time the " William Fawcett " would give them in the Bay of Biscay, butting into a south-west gale. Things were beginning to happen at sea, for in 1838 the Atlantic was conquered by four primitive steamships, the " Great Western," " Sirius," " Royal William " and " Liverpool." This was a most memorable year, and from that date the sailing packets were to receive their first hint at dismissal. For note what followed.

The Admiralty invited tenders for the carrying of mails to America by steamer, and the immediate result was that Samuel Cunard, a well-known merchant and sailing ship owner of Halifax, and George Burns and David M'Ivor all got together a capital of £270,000, made an offer to the Admiralty of a fortnightly service between Liverpool, Halifax and Boston, carrying Her Majesty's mails, and this offer was accepted, a contract for seven years being signed. Presently four ships were to be built and the Government granted the owners a subsidy of £81,000 a year. It was thus that the great Cunard Line came into existence, the four ships—all built of wood and propelled by paddle wheels—being the " Britannia," " Acadia," "Caledonia " and " Columbia." They were all constructed in 1840 on the Clyde by four different builders, with side-lever engines by Robert Napier. Barque-rigged (as compared with the brig-rigged "William Fawcett," which had been originally intended only for the Irish Sea), these four ships had accommodation for 115 cabin passengers and could carry 225 tons of cargo. Their speed was about $8\frac{1}{2}$ knots with 740 indicated horse-power. The dimensions of these four were pretty much the

same, the " Britannia " being 207 ft. long, 34 ft. 4 in. beam, 22 ft. 6in. deep, and the burthen 1154 tons.

The coloured photograph of the model should be compared with that of the " William Fawcett," and shews a similar type but larger and improved for trans-Atlantic as compared with narrow-sea service. The rigging, the lines at bow and stern, the clumsy quarters, the ugly stern—all the worst features of the old cumbrous East Indiamen which the early steamship builders accepted almost reverentially—are very much those of the first P. & O. ship, yet the newer vessel is a stage more seaworthy if still relying very much on her canvas. The barque rig rather than the ship rig of contemporary ocean-sailing vessels was retained, but in order to make room for the engines, funnel and bridge, the mainmast has had to be shifted a long way aft. But the familiar colouring of the Cunard red funnel with black boot-top is instituted, as it has been continued down to the mammoth present-day " Berengaria."

It was in 1840, too, that the newly-formed Royal Mail Line entered into an agreement with the British Government to carry Mails in steamships " of not less than 400 collective horse-power " to the West Indies. Fourteen ships were therefore built, all named after rivers, and here again they were given yards and plenty of canvas, paddles being used as before. In that year 1840 the Pacific Steam Navigation Company was granted its charter, and it was through the enterprise of these two companies that South America was to be kept in close touch with Europe to the great advantage of trade and development. The two companies have long since amalgamated, but with these important concerns, together with the Peninsular, and the Cunard all inaugurated within a very few months of each other, and all putting their faith and capital into the new paddle steamer as the future means of ocean transportation a tremendous and historic

impetus had been given to the most revolutionary phase of shipping ever since the sail had displaced the oar. It required an immense amount of pluck, considerable foresight, and demanded from the builders and engine-makers the very utmost that they could provide.

As far back as 1834 early paddle steamers were running a daily service between London and Woolwich. Wood, of course, continued for some time to be used for the hulls of ships, though in 1832 the first steamers of iron to be built on the Thames were 120 ft. long. These were the "Lord W. Bentinck," "Thames," "Megna," and "Jumna," for the East India Company. They were designed to navigate the Ganges and drew only a couple of feet, but this use of iron was another amazing innovation, seeing that ever since the sixteenth century all the East Indiamen had been constructed on the Thames of wood. The block model here reproduced gives some idea of these four craft.

One is so accustomed nowadays to the Navy taking a lead in all that can improve the design and propulsion of the ship that it is amusing to realise how conservative the British Admiralty and Naval officers were a hundred years ago. They did everything possible to prevent steam being introduced into the service, and the attitude was never more accurately summed up than in the words of Henry, first Viscount Melville and Baron Dundas. He was First Lord of the Admiralty, you remember, under Pitt from 1804-5, and delivered himself of the notorious pronouncement that it was the duty of the Admiralty "to discourage to the utmost of their ability the employment of steam vessels, as they considered the introduction of steam vessels was calculatcd to strike a fatal blow to the naval supremacy of the Empire." Could any prophecy have been wider of the mark?

Melville died in 1811, and ten years later the Admiralty purchased

their first steam vessel, a 210-ton paddle craft called the " Monkey " ; and between the years 1823 and 1840 the Royal Navy added as many as seventy steamships to their list, most of them being driven by side-lever engines, the first iron warship being the " Nimrod," which was launched in 1839. This was an armed paddle steamer, 103 ft. long, which had been built to the order of the East India Company, but in 1846 there was a distinct advance by the ill-fated steam frigate " Birkenhead," which was to founder six years later off Simon's Bay. Still, she was a 1400-ton ship, built of iron, with paddle-wheels, and it shewed that the Admiralty's prejudice was breaking down. The first iron steamship owned by the Royal Navy, however, was the paddler " Dover," launched in 1840 at Birkenhead.

The designation " paddle frigate " exactly indicates the fusion of the old and the new ; the joining of the old sailing ship days with the era of steam. Paddle-frigates were the forerunners of our modern light cruisers, and about the year 1840, when so much activity was beginning, both British and foreign navies began to introduce these craft. The illustration of a model of a paddle frigate belonging to that period will shew how the " Comet " had handed down her influence to ships of war. This paddle-frigate class was of wood, with oak frames and teak planking, the engines being side-lever, but the steam pressure did not exceed 15 lbs., and the speed was from 7 to 12 knots. This model represents a 32-gun ship with a telescopic funnel and rigged to sail independently of steam. She was of 1400 tons burthen, 210 ft. long and 40 ft. between the paddles. Observe that she carries two specially designed flat-bottomed boats to go over her paddle-boxes.

But now there comes into our story the introduction of the screw propeller. We have already seen that Stevens had, as far back as Fulton's time, employed this method of propulsion, but the idea had

lapsed in favour of the popular paddles. Then thirty years later in England Francis Pettitt Smith, a Hendon farmer, patented his screw invention and put the idea to a successful practical test in 1836 in his steam launch "Francis Smith," built at Wapping. The propeller was made of wood, and subsequently when a metal one was substituted she used to run trips between the Thames and Folkestone, her speed being $5\frac{1}{2}$ knots.

Now with Smith had collaborated John Ericsson, a celebrated Swedish engineer, and the latter also brought out a patent screw propeller which was tried first in the 45 ft. "Francis B. Ogden," in the first year of Queen Victoria's reign, and then in the larger vessel "Robert F. Stockton," of 33 tons, on the Thames, when she attained a speed of 13 knots with a fair tide. But a sydicate was formed and purchased Smith's patent, and the result was that the 240-ton steamer "Archimedes" was built in 1838 and fitted with a propeller. She was able to steam at 8 knots against wind and tide, went round the British Isles, down the Bay of Biscay, and finally convinced even the Admiralty that the screw-propeller was the thing. The reader doubtless remembers the story of the "Alecto," one of Her Majesty's paddle sloops, being made fast at the stern to Her Majesty's screw sloop "Rattler," and both being allowed to go full speed ahead. Although both ships were very similar in size and horse-power, the "Rattler" with her screw propulsion was able to tow the other's stern at a speed of two knots. That was in April 1845.

But already the screw had been accepted by the Mercantile Marine, and if you will turn to the model of the "Great Britain" you will see that here we have a most interesting ship. For three years after Smith had experimented with his steam launch there began to be built the first large iron vessel and the first screw steamer that was to cross the Atlantic. She was to be 322 ft. in length over all, and

because she was thus a hundred feet longer than the largest line-of-battle ship of the time it was originally intended to call her the "Mammoth." She was built of iron and not of wood, on the advice of Brunel, the great engineer of the time, for he believed that it would be impossible to construct of wood such a vessel of 3618 tons displacement: the furthest limit had been reached, the days of steel shipbuilding had not yet commenced. She was to carry 1200 tons of cargo, 1000 tons of coal and 260 passengers.

For this enormous undertaking no contractor could be found, so the Great Western Steamship Company (which had previously built the "Great Western" that crossed the Atlantic) laid down at Bristol the necessary plant and built her themselves under Brunel's supervision. Originally it was intended to give her paddle wheels, but the arrival at Bristol of the "Archimedes" caused Brunel to modify the designs so that she should be screw-propelled. The construction began in 1839 and in 1843 she was completed, though she did not leave until January 1845, when she steamed to London at an average speed of over nine knots. That same year she crossed to New York in 15 days and came back to Liverpool in fourteen, her best day's run being 287 knots. There is nothing wonderful in these speeds if we compare them with the speed of some of the fastest Atlantic clippers. For the "Donald M'Kay," for instance, in her maiden voyage to Liverpool, made a day's run of 421 miles, and in 1854 the Black Ball clipper "Lightning" during her maiden voyage to Liverpool actually did 436 miles on March 1.

But the point is that the "Great Britain" was a bigger ship and steam propelled with a screw, and her achievement was even more important for what followed. It is from her that we can trace directly the mammoth liner of to-day; it was the "Great Britain" and Brunel's imaginative genius which made this possible. Of course,

she was a monstrosity, yet she was a most interesting and daring experiment. She could set an enormous amount of canvas and this came in extremely useful, for later on she broke her six-bladed propeller but was able to carry on to Liverpool under sail, doing her ten knots and more. She was then given a new four-bladed propeller and continued in the Atlantic service till 1846 when she got ashore in Dundrum Bay, County Down. Here for eleven months she lay, but Brunel had a breakwater constructed to protect her, so she was refloated and taken into Liverpool. Of course, she was considerably damaged, and her owners sold for £24,000 the ship which had cost nearly £100,000, but the mere fact that she had survived all that buffeting proved that iron for shipbuilding was a perfectly sound innovation.

The " Great Britain " marks one of the most important phases in the whole of maritime history, and is one of those failures which are far more important than many successes. In her construction she had been specially strengthened longitudinally and divided into six watertight compartments. She also had bilge keels to prevent excessive rolling, her extreme beam being 50½ feet. Her nominal horse power was 1000, though double that was obtainable, and she could be whacked up to 12 knots. It is a credit to her builders that in spite of her vicissitudes the " Great Britain " is still afloat, and what is more, she is a floating wool warehouse, which is proof enough that she is pretty tight. She is lying at Port Stanley, Falkland Islands, and now that Nelson's " Victory " has come ashore, the " Great Britain " and the " Cutty Sark " are the two most famous vessels afloat. After she had been sold as mentioned, she was given new engines, a three-bladed propeller, and the number of masts was reduced to four, and from 1852 until 1874 she was employed in the Australian trade. Afterwards her engines were removed and she became a pure sailing ship.

I make no apology for collecting whilst it is still practicable as much information as possible whilst this eighty-year-old ship is still alive. She went out from the Mersey to Capetown in forty-five days during her first Australian voyage in 1852, her time to the Equator being only sixteen days. That was the year, you remember, following the Great Exhibition, and she became an exhibition ship herself for visitors, where hundreds inspected her daily in port. Her new engines were on the oscillating principle, and the shaft could be disconnected when she was solely under sail. During that voyage in 1852 she ran out of coal before reaching Capetown, so Captain Mathews, her commanding officer, put about, took advantage of the south-east trades and ran back to St. Helena to replenish. Her original six masts were nicknamed by her crew " Monday, Tuesday, Wednesday, Thursday, Friday, Saturday," and with her black square ports on white ground she kept up the old tradition of being painted Nelson fashion.

The model of the " Hibernia " represents a ship of 1422 tons, 219 feet long, with a speed of 9¼ knots. For those first four Cunarders had been so successful that now the increasing traffic required two more ships to be added. Thus the barque-rigged paddler was built of wood in 1843 and her sister ship, the " Cambria," two years later. These two Cunard ships were bigger, a little faster, and had greater accommodation than the original quartette; and then in 1847 the rapidly extending commercial relations between Britain and America necessitated the doubling of the Cunard service, so in the following year four new ships—the " America," " Niagara," " Canada " and " Europa "—were completed, and by 1852 the " Asia," " Africa " and " Arabia " were added.

All these craft were paddlers and built of wood, but now, as in the " Arabia," one of the three masts was done away with and a

second funnel was added. But it was not until 1852 that the Cunard Company tried iron, or the screw propeller, and during that year they introduced to their fleet four iron screw steamers. The paddle-wheel, however, was still so popular among passengers that in 1856 the company actually reverted to the old type, and the iron paddler "Persia," with two masts, two funnels, and accommodation for 250 passengers, was built. This was a big ship for those days, being of 3300 tons burthen and 3600 indicated horse-power, and six years later an improved "Persia," named the "Scotia," of 3871 tons and a speed of 13 knots, came out as the finest merchant steamer afloat. She was responsible for reducing the New York-to-Liverpool passage down to eight days twenty-two hours, and thus the glory of the trans-Atlantic sailing ships was gone for ever. For years the "Scotia," of which you will here see a model, was supreme, but she was the last of her race, for the Cunard corporation never owned another paddle passenger liner.

We see then how the original hull of the sailing ship had gradually become influenced, the design modified, the canvas decreased, engine power increased, finer lines taking the place of clumsiness as a more perfect knowledge of naval architecture was gained; and, finally, the use of the screw and of iron becoming essential. Curiously, in spite of the fine send-off which the "Clermont" had given to the steamship in America, that country did not make the progress which might have been expected in this respect. It is true that from 1850 to 1858 the Collins Line, subsidised by the American Government, did put up a keen competition against the Cunard ships, but eventually the former retired. This was all the more remarkable as the American sailing packets had made such wonderful records across the Atlantic.

The Hudson river passenger steamers had, however, continued, and the model here shewn of the "Empire" represents a wooden

vessel built in New York in 1843 to run up the river to Troy. In her we see one of those typical American river-boats with fine lines, long flat floors, a half-beam engine, and wooden paddle wheels. The model of the other river steamer shews the first paddle-wheel passenger craft to navigate the Danube. This was a 450-ton vessel built at Buda-Pesth, and she drew only three feet. Thus, by the middle of the century, at the time when such fine sailing ships as the Blackwall frigates were making so brave a show, and the American clippers were in their prime and piling up records in almost every sea, the young steamship had pushed her way across the ocean, into European and American rivers, and had come to stay. I think, when you consider the matter calmly and even at this short distance of time, there never was such a period of amazing shipping vitality and competition as from about 1840 to 1870, when the whole future of marine transportation was being fought out with extraordinary energy.

The influence of that original thinker and experimenter, John Scott Russell, with his valuable contributions to the knowledge of a hull's resistance in passing through the water, has been invaluable in the improvement of ship design. He was in his prime in the 'fifties, and the design of the famous "Great Eastern," built at his yard in 1854-8, followed out his wave-line principle. It was, however, Brunel who suggested the building of a ship about six times larger than any existing steamer, and it was his idea, too, of giving her both paddle wheels and a screw. She was a costly freak and of such a size that she was the biggest vessel ever built until the White Star "Baltic" appeared in 1905. But the courage and imagination, the professional skill and enterprise of both Scott Russell and Brunel are something of which the mid-Victorians may well have been proud. The "Great Eastern," of which a model is here given, was really

ahead of her time, though the basic principle was sound enough that length meant speed, that the bigger ship would need less power per ton than smaller steamers; and that the " Great Eastern's " superior passenger accommodation, cargo space, and fuel capacity would make her a commercial success.

There was never a ship of her length till the White Star "Oceanic" in 1899, and there was never a vessel with greater beam until the " Mauretania " and " Lusitania " arrived. If you look at the hull, especially the fine entrance, you can see at once that even the contemporary Atlantic liners with bowsprits and clipper bows seem to belong to the days of the past rather than the present. If the " Great Eastern " was an expensive failure, another alarming monstrosity, she was but paying the heavy price which every pioneer has to suffer; she was doing more than Brunel and Scott Russell could ever have realised to bring about the reliable mammoth liner of to-day. Actually, her original name was the " Leviathan," and the following dimensions will justify her title: displacement 27,884 tons, length on upper deck 692 ft., beam across paddle boxes 120 ft., draught of water laden 30 ft., coal capacity 10,000 tons, cargo space 6000 tons, paddle engines 1200 horse-power, screw engines 1800 horse-power, accommodation for 4000 passengers.

It is interesting to observe that in addition to two hawse pipes on either bow, the " Great Eastern " had also a couple, one over the other, in the stem head above the water line; and I never remember to have seen this idea repeated until I saw the hawse pipe in the stem of the German-built, White Star-owned, mammoth " Majestic." With her five funnels, six masts (carrying up to t'gallants on the second and third masts and only one yard on the third mast, the rest being fore-and-aft rigged), the " Great Eastern " was at least impressive; perhaps the most awe-inspiring merchant ship the sea has

ever beheld. She was not launched at Milwall until January 31, 1858, and then sideways, three months after the first attempt. This delay led to financial difficulties, work was suspended, she was sold to a new company for £160,000, and it was not till September 1859 that she made her trial trip. In the following June she first crossed the Atlantic, her best speed being 14½ knots, which was quite considerable when we consider the immense problems. But neither as a passenger nor a cargo ship was she a commercial success. From 1865 to 1873 she was, however, useful for laying Atlantic cables, after which she ended her career and was finally broken up by 1890.

From the merchantmen let us now pass to see the development and radical changes which steam was bringing about in ships of war. The model of H.M.S. "Highflyer" shews a ship-rigged, wooden corvette built at Blackwall in 1850-1 from Admiralty designs. In this craft we see a vessel of 1775 tons armed with a 10-inch pivot gun and firing a broadside of twenty 8-inch guns. She was one of the first men-of-war to be fitted with the lifting screw, a device that was employed when the ship stopped steaming and relied on her sails. There are alive retired naval officers who tell amusing stories in connection with this evolution of putting the propeller out of gear. The "Highflyer" could steam a little better than nine knots, but she was characteristic of a ship-type that combined in itself the influence of the earlier sailing clippers, the old corvettes and the gradually-improving steamship. You will observe the same standard of achievement in the model of the U.S.S. "Hartford" of 1858. This was a steam frigate, and was Admiral Farragut's flagship at the battles of New Orleans (when he brought about the surrender), Port Hudson and Mobile Bay during the American Civil War. This model is in the museum of the United States Naval Academy and is particularly interesting because it was a time when the American influence of the

sailing frigate had long since passed, but its clippers had made their indelible mark on contemporary naval architecture of the world. The "Hartford," therefore, represents the finest expression of the best period of American sailing ships just at a time when steam was about to alter everything.

All those memoirs of officers, naval and mercantile, belonging to our own or any other country, who served during the interesting transition period from sail to steam will, before another two generations, form invaluable material for future history. We are too near that period yet to feel the thrill of romance which rightly belongs to this mid-Victorian era; but all the little anecdotes, the personal conversations, the special kind of seamanship, the prejudices of the older officers and men against machinery, the difficulties into which these auxiliary vessels were involved and the way they extricated themselves—all such details will enthrall our descendants.

It seems incredible to us who belong to the age which has seen the Battle of Jutland that in the previous century theAdmiralty should be so uncertain and indecisive during the period of this sail to steam transition. They wanted in their minds to stick to sail, but every day it was obvious to less conservative bodies that steam was inevitable. The spirit of Nelson had become almost too inconvenient a tradition because it would not be modernised. Thus, line-of-battle ships and frigates were laid down, pushed forward rapidly for a time, then suddenly left alone on the stocks for years, and finally taken to pieces. Such unproductive expenditure would now-a-days cause a public scandal: yet it was not confined to the British Navy and it was really owing to the revolutionary change which in the shipbuilding world was then at its very crisis. The six-foot model of the U.S.S. "Colorado," from the same United States Naval Academy, gives another instance of a steam frigate at this transitional time. Launched

in 1856, the" Colorado " played an important part in the American Civil War, especially at Fort Fisher. She was also the flagship of Rear-Admiral John Rodgers in the attacks on Salee River forts, Korea, during June 1871. But an excellent instance of shipbuilding indecision, caused by the transformation and capsizing of naval ideas owing to rapid developments, is to be seen in the case of the U.S.S. " Antietam ".

The model here shown is 50 feet long, and one of the largest in the world : it is certainly one of the most instructive. Here you have a vessel officially called a 23-gun steam sloop of war. When the " Antietam " was laid down in 1862 she was regarded as the last word in naval construction, but then came the wave of new thought so that hesitation followed and delay. The nett result was that she became obsolete whilst on the stocks and was not launched till 1876 and thereafter used only as a store ship. This lovely model is in the gymnasium of the United States Naval Academy and though you cannot see her propeller or funnel, you observe at once the potent influence of the clipper ships during the late 'fifties. You have only to consider the famous American clippers " Flying Cloud " of 1851 and the " Great Republic " of 1853 to see that immediately. In this " Antietam " model with her royals and stuns'ls she reflected that old-time spirit which so bravely yet ineffectually was defying the advent of machinery.

Perhaps nothing can bring home to us more powerfully the incongruity of the old style and the new—the fashion of Nelson's " Victory " and the muddled thinking that was neither up-to-date nor of yesterday—than the model of the " Howe," which is in the Royal Naval Museum, Greenwich, and is here reproduced. Here you see the mind of what we should nick-name to-day the " last-ditcher," the " die-hard." Between 1855 and 1860 the Royal Navy built a number of screw three-deckers which were almost perfect

specimens of what could be wrought with wood as the result of three hundred years' experience in the art of warship construction in the Royal dockyards. The " Howe " is one of these three-deckers, built at Pembroke in 1860, and shews how reluctant was the will to conceive of a capital ship being anything else than a Nelsonian wooden wall, even if she had to be given a couple of funnels and a propeller. At any rate, she could still carry her 121 guns, retain her old-fashioned square ports, the Nelsonian fashion of painting, and even her seventeenth century stern galleries. This was a vessel of 4245 tons, and her guns, mountings and projectiles were essentially much the same as they had been in the time of Queen Elizabeth.

But a change was coming, a very big change, and one as revolutionary as the introduction of steam. It was the Crimean war that was directly responsible. The history of British ship design, as I have shewn in other volumes, is one long story of the influence on us by the best examples in foreign navies. Just as in the mediaeval times we learned from the ships of the Mediterranean; just as in the sixteenth century we were taught much by the Portugese and Spaniards; in the seventeenth century by the Dutch; in the eighteenth by the French; and in the first half of the nineteenth by the Americans, so at the middle of the last century we were to learn again from the French, just as the Great War has enabled us to learn many valuable points from the German ships. I hold that it has always been a characteristic of the English race—certainly since Tudor times—to have an open mind for other people's novelties and then, having adopted them, to improve them till they become something entirely novel in themselves.

In the olden days, during the Anglo-French wars, it was complained that our ships were inferior in design to the French, and when the latter captured any of ours they were either given a lower rating

or discarded. In 1806 we established a school for evolving better shipwrights, and then in 1832, instead of a member of the School of Naval Architecture being appointed, as had been the custom, Captain (afterwards Sir William) Symonds was made Surveyor of the Navy. He was of an independent mind and was responsible for ships being given greater beam and finer lines, though as late as 1850 one-third of the ships in the Navy List were based on foreign design. But he was no friend to steamers. " I consider," he stated, " steamers of every description in the greatest peril when it is necessary to use broadside guns in close action; not alone from their liability to be disabled from shot striking their steam chest, steam pipe, machinery, etc., but great probability of explosion owing to sparks from funnel."

The " Howe," mentioned above, was 260 ft. long, and was the last of the three-deckers, but she was at the time of her launching in 1860 more out-of-date than was appreciated. Why was this? The answer really goes back to 1825 when Colonel Paixhans, a distinguished French officer, who had introduced horizontal shell fire instead of shot, suggested ships should be given a cuirass of seven or eight inches of iron. He was ahead of his time, but his idea was the right one, though it was not until the Crimean War it was unmistakeably demonstrated that an unprotected wooden ship could not endure the effects of shell fire: for in the race that was beginning and still continues, the gun had outrun the defensive power of the warship.

In England we were still too content, too conservative, too relying on " what was good enough for Nelson is good enough for us." But the analytical French mind got to work, and her great naval architect, Dupuy de Lome, selected a two-decker wooden ship and placed outside 5 in. armour plates with wood backing, the work being completed in 1859. Thus there came into being the historic first ironclad, which we know by the name of " La Gloire." British public opinion

was roused, the Admiralty had to wake up, and in that same year Sir John Pakington, First Lord, gave an order for the " Warrior," our first ironclad to be built, and this in spite of hostile naval opinion.

The " Warrior," of which the reader will see here a model, was an iron screw frigate of 9000 tons displacement, and as she was not built of wood she was at once an improvement on the French idea. The influence on her design is largely traceable to Scott Russell, especially in the use of iron and the structural arrangements. She was protected by 4½ inch armour with eighteen inches of teak backing, and she also had transverse armour bulkheads, the ends of the ship being without armour. Her great length and power made her still more superior to the French ship, for the " Warrior " was 380 ft. long, 58 ft. broad and could steam at 14 knots. She was armed not with the ancient smooth-bore artillery, but with forty 110-pounder rifled, breech-loading Armstrong guns; and thus in every respect the " Warrior " became a unique ship, embodied all that science and art, tradition and invention, the Navy and the Mercantile Marine could possibly produce.

It was the beginning of a new era, it was the foundation of all modern navies of the world, it gave a fresh course to the development of sea power, and the wooden wall period was relegated to ancient times. From the date of the " Warrior," Britain has occupied the leading position in the development of naval architecture. At the Admiralty such distinguished naval constructors as Sir E. J. Reed, then Sir Nathaniel Barnaby, afterwards Sir William White, and then his successors during this present century, have, with the inspiration of such scientific engineers as Rankine and Froude, made British shipbuilding in sixty years something too remarkable to be assessed lightly. It is an achievement which will stand out, as time goes on, more wonderfully than most of

us suspect. Three more ships of the " Warrior " type followed this successful vessel, and then we find another vast change to which the warship must submit herself.

The idea came from the American Civil War, for the duel between the original " Monitor " and the " Merrimac " shewed the important value of the turret system in action, though Captain Cowper Coles of the Royal Navy had even in 1855 been urging the mounting of a gun in a revolving turret and placing this in an iron plated vessel of low freeboard. The American " Monitor " was a 614-ton ship built of iron, protected with iron armour 4½ inches thick, but the vessel's freeboard was only a couple of feet above water. In the centre of the deck was a circular turret revolving on a spindle and containing a couple of 11-inch smooth-bore guns. The tactical advantage, as compared with the position then still customary in ships, was that by means of these turrets the guns could be trained to fire in any direction without altering the course of the ship. The model of U.S.S. "Benton" of 1861, here reproduced from the United States Naval Academy, illustrates one of the river gunboats in use during the Civil War. These were shallow draught craft with stern wheel propulsion, and their low freeboard made them less prominent targets : they were, in fact, mobile floating batteries. She did not, however, possess the " Monitor's " revolving turret.

In England at this time naval strategy was still in its most elementary state, naval history with its invaluable lessons was rarely studied ; consequently, there grew up that wicked heresy summed up in " coast defence," and even during the recent Great War it raised its ugly head again after the East Coast of England was bombarded and parochial opinion was anxious to tie down naval forces locally. The immediate result of the American " Monitor " was the creation of the first British turret ship, " Royal Sovereign," in 1864, with her

six-feet freeboard, designed and supervised by Captain Cowper Coles, and the idea was pushed a stage further with the " Monarch," which was designed by Reed as a sea-going turret ship.

But in deference to popular opinion Captain Coles was allowed to design a sea-going turret ship according to his own ideas, and to choose Lairds of Birkenhead to assist him in preparation of the plans, the Admiralty promising to build such a ship if they should approve of the design. To use Coles' own words, his idea in this ship was to enable her to carry "the heaviest ordnance that would destroy any iron-clad in existence, to obtain an all-round fire, and to be efficiently carried on a minimum beam and tonnage, with a maximum speed, at the same time showing a minimum area above the water-line to be plated that can be given to ensure safety to the vessel at sea, and render her habitable for the crew in all climates." This ship was built at Birkenhead and floated out of the dock on March 27, 1869. She was an iron, twin-screw vessel with two turrets, the armour plating being here ten inches thick with eight inches at the sides but reduced at the ends of the ship.

This was the well-remembered " Captain," 4272 tons, ship-rigged with royals and headsails. If you refer to the half-model here reproduced from the Royal Naval Museum, Greenwich, you will see the two turrets, each of which carried four 12-inch (25 ton) guns, but in addition she carried a 7-inch gun forward and aft. Her speed under steam was 14 knots. The fo'csle and poop were essential to protect the deck and turrets since the freeboard was to be only eight feet (though, as a fact, it was only six and a half feet when the vessel was finished). Now, although the poop and fo'csle were for a protection against spray and seas, they actually interfered with the horizontal command of the guns. A flying deck, as will be noticed, connected fo'csle and poop.

Captain Hugh T. Burgoyne, V.C., R.N., was given command of her, and with him as his guest went Captain Coles. On the night of September 6, 1870, during a squall the " Captain," whilst under sail, capsized off Finisterre, only eighteen of her five hundred crew being saved. The verdict of the subsequent Court of Inquiry was not illuminating but remarkably vague. It was hardly calculated to clear up uncertainty when it reported that the " Captain " was capsized by a pressure of sail assisted by a heave of the sea, and that the sail carried at the time was insufficient to have endangered a ship endowed with a proper amount of stability. The point was that ship-designing is the job of a naval architect and not a naval officer. The advisers of the Admiralty had all the time been opposed to the design, but the whole defect seems to have been that the calculations had been made on inadequate data. In fact, the Committee on Designs appointed in the following year under Lord Dufferin made it necessary to have more detailed calculations for stability in the future than had hitherto been the case.

This was another of those crises in the development of the warship, and both the Admiralty and naval architects had to face such important questions as would not delay any longer: the whole future of the capital ship was now being laid down. What was the best method of employing armoured protection so as to secure the greatest resistance to shell fire? What was the best method of disposing a ship's armament? Over a whole broadside? In turrets? In a so-called " box battery?" Was the ideal man-of-war a long, fine-lined vessel like the " Warrior " or a short ship? It was, of course, the public anxiety in regard to the seaworthiness of ironclad ships that brought the Committee into being, but amid all this discussion the main offensive character of the ship was lost in the excessive consideration which at that time was being devoted to armour defence. The first

essential of a ship is to float and fight : the more tons of armour with which you protect her the less weight she can carry in armament.

With the launch of the " Thunderer," " Devastation " and " Dreadnought " in 1872 the days of the sailing line-of-battle ship had definitely gone. Look at the model of the " Devastation," taken from the Royal Naval Museum, Greenwich. Masts and spars have disappeared except for purposes other than canvas-carrying, the all-round gun-fire turrets have come to stay, steam power and twin screws have been found essential and reliable, a " military mast " with its fighting top, its topmast and yard for signalling are there. In the opinion of the above committee, the " Devastation " class with its abandonment of sail, its thick armour and powerful guns, represented the broad features of the " first-class fighting ship of the immediate future." The " Devastation " was called a monitor by the naval architects of her day, as indeed she was, though she outstripped in power and seaworthiness any ship with which that name had been associated.

In each of the two turrets were a couple of 35-ton guns, the side of the ship being protected with 12-in. armour, the breastwork by 10-in. and the turrets by 12-in. and even 14-in. Great reliance—another heresy—was set at this time on the ram. It was the " knock-out blow " idea based on insufficient information again. If you examine naval history you will find that ramming has always been extremely difficult in practice, and in effect almost as injurious to the attacker as the attacked. This was the case with the Roman galleys and it was so during the Great War, when the galleys' descendants, the torpedo-boat destroyers, made for enemy submarines. If you have ever seen, as I have, a destroyer limping into port, bows down and stern up after ramming a submarine, you will understand at once. Destroyers are remarkable for their handiness, but the " Devasta-

tion " (9330 tons), and her bigger daughters, would have been difficult in any such knock-out tactics against other ships, notwithstanding the disastrous accident between the " Victoria " and " Camperdown."

The " Devastation " was only 285 ft. long between perpendiculars, yet we have arrived now at that stage when we can see the modern capital ship bearing some resemblance to her ancestors. The model of the " Glatton " (also from Greenwich) shews a single turret monitor, forty feet shorter than the " Devastation " and carrying two 25-ton guns. She was floated out of Chatham Dock in 1871 and was intended for coastal defence; that is to say, a floating fort. You will observe that she was accordingly given very little freeboard—only three feet—and her sides were protected with 12-in. armour.

It will come as a surprise now to find that in the " Inflexible " we jump back to a ship with masts and yards, but the reason was as follows. This vessel was originally designed in 1873, but her plans were strongly criticised, especially by Reed, who had resigned his post as Chief Constructor of the Admiralty three years previously. She was laid down early in 1874 and not completed until October 1881. The delay arose through the uncertainty as to the design for the heavy guns that were to be placed in her two turrets. At first she was to have 60-ton guns, but finally two 80-ton guns were decided on for each turret. This, of course, meant increased weight, so the design, the draught and displacement of the " Inflexible " had to be enlarged. This was the first of a long series of costly delays in the construction of ships, owing to the fact that the size of their guns had eventually to be revised. She was brig-rigged out of deference to the representations on the part of a minority in that Committee on Designs. You see that old conservative, "die-hard" spirit cropping up again, but it was not for long. The sail-power was found useless and given up.

The model is in the Greenwich Museum and will always be interesting, as the ship was first commissioned by Captain John Fisher who afterwards became Lord Fisher and was First Sea Lord at the Admiralty during part of the Great War. Under his command she took part in the bombardment of Alexandria, and it was for these and subsequent shore services that he received his C.B. When at last completed the " Inflexible " was 320 ft. long, of 11,880 tons displacement, and her steaming speed was 13¾ knots. Her compound engines for the twin screws enabled her to be more economical with the same endurance as " Devastation," and so she carried 1200 tons of coal instead of 1700 tons. Her four 16-inch guns required hydraulic apparatus, which cost nearly £50,000. Amidships her armoured citadel extended 110 feet horizontally, for the entire 9½ feet of her freeboard and another 6½ feet below waterline vertically. This vessel was given a protective deck; minutely sub-divided watertight compartments packed with cork being in the spaces above. The two turrets were placed en échelon to give greater horizontal command, and all four guns could be fought ahead, astern and on each broadside.

This " Inflexible " was the first battleship to be fitted with internal electric light and submerged torpedo-tubes. With the origin of torpedo-boats we shall deal presently, but the time had now come for defence to be taken against them, so eight 4-in. guns were mounted in the " Inflexible " for that purpose. But all this while British progress in shipbuilding, and the rise of big firms who specialised in the design of war vessels, and most of all the scientific minds at the back of all this, had the effect of attracting other nations who possessed ambitions on the ocean or wished to protect their own shores. The adoption of coal and steam and metal had made the world's older warships useless. Sea-power now meant the possession and use of vessels and weapons which were articles of the greatest refinement

in their manufacture. Always there has existed between the British Admiralty and the big shipbuilding firms a close association, and it has enabled the latter to accept orders from foreign powers under favourable conditions.

You may argue that the foreigner has therefore benefited by British Admiralty designs, but on the other hand an order for a battleship enables the private shipyard to keep going until the next man-of-war is required by the Royal Navy. You may cut down armaments and restrict the numbers of a nation's fleet, but it has always seemed to me that the country which has ready the largest number of efficient yards and slips at the outbreak of strained relations will be in an already enviable position. There was an instance during the recent war when we were able to take over and add to our fleet a number of valuable war vessels that were being built for other powers. And this has gone on for many years.

The model of the Turkish armour-clad frigate "Osmanea" was one of three ships built of iron on the Clyde in the years 1864-6. They were vessels of 6450 tons displacement with a speed of 12 knots. Turkey has been a good customer to Britain, but Japan has been far better, until now we have taught her most of our own secrets, and she is able to build most of her own requirements. The delightful model of the sloop "Seiki" shews to what skill the Japanese had attained even in 1875. The design and rig and everything else about her are directly traceable to British auxiliary cruisers and contemporary steamship liners. The original "Seiki" was constructed at Yokosuka, and this model was presented in 1910 to the Royal Naval College, Greenwich, by the Japanese Government in gratitude for the courtesy extended to the Japanese constructors and engineers who had studied at the above college. This was a vessel of 897 tons, armed with one gun. Japan's indebtedness to us is very considerable,

as she has had of our very best. As far back as 1879 Dr Francis Elgar, who eventually became the first University Professor of Naval Architecture in Great Britain, went out east to become special adviser on naval construction to the Imperial Japanese Navy. For many years he was Reed's assistant and was destined to become at the British Admiralty afterwards Director of Dockyards.

So, too, in America, especially in Brazil and the Argentine, British-built warships have been in demand for many years. Even Mexico and Portugal were our customers in 1875, as the next two models prove. The first shews the " Mexico " which, with her sister ship the " Democrata," was built for the Mexican Government in that year. These three-masted gunboats were schooner-rigged and constructed of iron. They were quite small—450 tons displacement, 140 ft. long, draught 11 ft.—and mounted two 4-ton guns as well as a couple of 20-pdrs. The second model shews the "Vasco da Gama," a twin-screw, iron-built, armoured battleship of 2479 tons; and it proves how in four hundred years history can work its revenge and alter conditions. For, as English designers and builders in the days of carrack and galleon derived from Portugal the most advanced ideas in regard to their avocation then, so the introduction of steam and iron had exactly reversed affairs. The " Vasco da Gama " was contructed at Blackwall, but ever since the time of Elizabeth, when the power of Portugal was on the wane, Blackwall had been building wooden East Indiamen, and now the Thames Iron Works were carrying on the old tradition under the new conditions.

The model of H.M.S. " Helicon " is interesting as this wooden despatch paddler, which was built at Portsmouth in 1861-5, was in 1885 converted into the Admiralty yacht " Enchantress." Notice the projecting cutwater or " plough bow." Reed, whilst he was at the Admiralty, had this craft altered forward and extended the cut-

water at the water line as here seen. During 1865 she was tried against the "Salamis," an identical vessel which did not possess this cutwater, and the result was that "Helicon" shewed herself the faster boat. Both the British and French men-of-war adopted the plough-bow in their early ironclads.

How, during this part of that fascinating nineteenth century, the ocean liner was developing the reader will readily see by examining the next models. We must not forget that this was the time when the clipper sailing ship was just reaching her peak of fame, and, therefore, it was but natural that the clipper bow should be retained in the steamer longer than might otherwise have been. Take, for example, the models of the "City of Paris" (1866), and the "Russia" (1867). They have not rid themselves of yards and sail, but they are in that transition stage through which the Navy had passed, and developments are pending.

The "City of Paris" was a single screw steamer built of iron for the Inman Line, which was the first Atlantic company to construct all its steamers of iron instead of wood. This famous corporation did a great deal in the progress of the ocean-going steamer, and from 1850, when it was founded, until 1892, was a powerful competing force against the Cunard and other ships. This "City of Paris," of 3081 tons, will not be confused with the still more famous vessel of the same name belonging to the same company and built in 1888. The "Russia" was 346 ft. long, being of the same length as the first "City of Paris." "Russia" was a Cunard ship, and both these vessels were justly famous for their exquisite lines and symmetry. In fact, when it comes to a question of beauty, these liners are far more to be admired than the modern development with tiers of decks like sea-going skyscrapers. As long as ever sail was retained in the steamship the deck-houses had to be kept low to allow of the men handling

the canvas. But you can see how the accommodation was altering, how before long another deck was bound to come. In the " Russia " the deck cabins are really an extension of the old sailing ships' deck-houses. In the model of the Cunard " Abyssinia " we have this arrangement developed a step further. The deck-houses have become an additional deck, and there are other new features, too. Gone are the clipper bow, the bowsprit and jib-boom ; a clean sweep has been made, much has been learnt from the best features of the " Great Eastern," and we are now in a thoroughly modern period. There is plenty to learn, there were many things which could only be found out by experiment, the tank, and research ; but already the shipmen knew whither they were wending. The " Abyssinia " and her sister ship belong to the year 1870 and were 372 feet long. Before you pass over the former and the " Russia " please notice what a frail, low, modest affair the captain's bridge was in those days and then consider the elevation in such ships as the " Berengaria " and " Majestic."

The " Arizona " model gives us an idea of another important ship. She was four-masted, single-screw, barque-rigged and built of iron in 1879 for the Guion Line, which was for a time another keen competitor on the Atlantic. She was of 5305 gross tons, 450 ft. long and 45 ft. broad, but the important fact is that she broke all records by reducing the passage between Queenstown and Sandy Hook to 7.3 days. However, in that same year that she began her service she crashed at a speed of 14 knots into an iceberg. Although her bows were crumpled up, she was kept afloat by means of her collision bulkhead and reached St. John's, Newfoundland, and was afterwards repaired. This incident and the influence of the British Admiralty had an important effect in the future arrangement of watertight compartments in merchant ships.

Steamship development and the progress of naval architecture

owe a very great deal to the competition which at this time was going on in the Atlantic. In size and speed and safety and comfort these western vessels were improving with every year. Exactly the opposite had been the conditions up to the early nineteenth century, and as long as the East India Company were allowed to retain their amazing monopoly. In those unprogressive days practically the same unimproved type of ship was repeated year after year, passengers had to put up with discomforts and dangers and be thankful for what they got. But the steamships of the western ocean altered all that, and one line still vies with another to attract the passenger, to pamper him with all the luxury which can be brought to sea from the shore.

In the model of the Cunard " Gallia " the date is only 1879, yet here is a vessel of 9255 tons displacement, a speed of 15½ knots, a main deck (with most of the berths), a spar deck with berths, a saloon, bathrooms also; and a promenade deck with ladies' cabin, smoking-room, and generally more comfort all round. She has an additional bridge aft, she is given a greater number of boats, and with her length of 441 ft. she can fight her way through ocean seas.

It is a pity that the earlier models of some steamships, including the White Star Line, are not available. The White Star Line did not enter into this Atlantic steamship competition until thiry years after the Cunard Line had ventured, but they have played an immense part in steamship progress. This concern had flown its flag in sailing clippers, but in 1867, when the managing owner died and Mr T. H. Ismay took over control, the latter began to introduce iron into the building of his Australian clippers, two years later gave an order to Harland & Wolff at Belfast to build steamships for the Atlantic, and so in 1870 was launched that lovely vessel the " Oceanic," which was not only the first White Star steamship, but was so full of fresh ideas and improvements that she began an entirely new chapter in the story

of the steamer. The saloon, for instance, was placed in the middle of the ship and not aft, the staterooms were arranged forward and aft of this and no longer opened out on to the saloon. Thus one more link with the clipper ship days was severed. This was a vessel of 3808 tons, and her beam was just one-tenth of her 420 feet in length. She had compound engines, a speed of just under 15 knots, and both literally and metaphorically set a new pace to Atlantic steamships.

But wonders and improvements were following each other quickly, and now we come to the steel age of shipbuilding. During the 'seventies steel had been used for shipbuilding more or less experimentally. Because of its ductility, strength and lightness it was more suitable than iron. The French had used it in 1873 for warship building, but in 1881 the Cunard " Servia " came out as the first cargo ship to be constructed throughout of Siemens mild steel. As you examine her model you will bear in mind that she was the largest vessel afloat (excepting the " Great Eastern "), and the first Cunarder to be fitted with incandescent electric light. She was a much bigger craft than the " Oceanic "—12,300 tons displacement, 540 ft. in length over all, 52 ft. beam—and was able to steam from New York to Queenstown in 7 days 1 hour 38 minutes. She was also included in the Admiralty list of auxiliary cruisers, and in the steel-protected steering-house aft arrangement was made for handling the ship by steam gear, hand gear, chain gear and by tackles. Canvas was still used and Cunningham's patent self-reefing gear was fitted to the fore and main topsail yards.

The model of the " City of Rome," built in 1882 and here included, shews a very beautiful ship-rigged, yacht-like hull, with a fine spread of canvas, no top-hamper, and decidedly not slow for her steaming speed was over 18 knots. You can see how rapidly the competition was pushing yesterday's ships into the background, and

size was growing amazingly, for here was a vessel of 11,230 tons displacement, 560 ft. long, and with four decks. But the greatest triumph of shipbuilding at that period was unquestionably the creation of those two exceptional vessels, the " Umbria " and " Etruria," of 1884-5. I have included here a perfect model of the former in which you will see guns mounted fore and aft as an auxiliary cruiser. Even the most prejudiced critic must admit that this steamship is a most lovely thing, and in the whole history of the Cunard Line they never had a couple of ships which were in every respect so satisfying.

The " Umbria " was a five-decker, with teak deck-houses on the promenade deck enclosing the entrances to the saloons, captain's room and chart room. You will see that already there has been introduced a flying bridge over the lower bridge and steering-house. The turtle deck aft for seventy-five feet and the hundred and ten feet of t'gallant fo'csle are characteristic. She still hung on to the barque-rig and carried a large spread of canvas, but the masts were steel. These two ships broke all records, the " Etruria " crossing from Queenstown to New York in 6 days 6 hours and 36 minutes. That was in 1885, and seven years later the " Umbria " beat this by keeping up an average of over 19½ knots. Many readers who were boys then will recollect the public interest which was taken in these exquisite creations, which became more efficient as they grew older, and they remained the two fastest ships of the Cunard fleet until the coming of " Campania " and " Lucania." The " Umbria," two days before Christmas in 1893 whilst west bound, fractured her propeller shaft, so her engines were stopped, and later she was taken in tow by a ship called the " Bohemia." But a gale sprang up and the tow-rope parted, and then for three days and nights the " Umbria " drifted about the Atlantic, but the shaft was temporarily repaired by her plucky and

resourceful Chief Engineer Tomlinson, so that she was able to steam slowly into New York on the last day of the old year, in spite of having been given up as lost by pessimists ashore. This couple of ships for a long time held the " blue riband of the Atlantic " and were not sold to the breakers until the end of 1909 and early the following year.

The schooner-rigged model of " Taroba " shews the best kind of steamer of 1888 in the London to Calcutta route. She was launched for the British India Steam Navigation Company, built entirely of steel, with three decks, electric lighting, hydraulic cranes for working the cargo, and a speed of 16 knots. She was a thoroughly up-to-date ship as to construction and improvements, though she was a much smaller vessel than " Umbria " and single-screwed. But we must turn to the " City of Paris " of 1889 if we want to see the summit of liner attainment of the 'eighties. This vessel changed her name to " Paris " in 1893, and afterwards to " Philadelphia," but it is as she was originally known that we shall refer to her. If you will look at the model you will find two quite obvious points about her that made her immediately recognisable at sea—the two funnels and the revival of the clipper, or rather schooner, bow with bowsprit, something after the manner of a steam yacht.

But she was unique in other ways more important. Her creation was due to the keen competition during that decade across the Atlantic. This Inman ship was a reply to the " Umbria," as the sister ship, " City of New York," was to compete against the " Etruria." The " City of Paris " was the first large ocean steamer to be fitted with twin screws and forced draught and the first vessel in the history of the world to cross the Atlantic in under six days. Her dimensions were 10,786 gross tons, length 527.6 ft., beam 63.2 ft., and she was twin-screwed with triple-expansion engines. Between the foremast and the fore bridge rose a great dome which lit the first

cabin dining-saloon, and was another effort to make sea-voyaging more comfortable than ever. But this ship had an eventful career; for some ships, like certain persons, seem to be born for adventure. In the year 1890 she was off the Irish coast when one of her propeller shafts broke, both engines were damaged as well as the hull, yet she got into Queenstown. In 1898 she was chartered by the American Government as the "Yale" during the Spanish-American war, and a number of quick-firing guns will be seen mounted in this model. During the following year she had the misfortune while steaming along the English Channel to get right out of her course and run on to the Manacles. She was seriously injured, salved, repaired, lengthened, re-engined, and then came back to passenger service as the "Philadelphia."

Many will remember that fast liner the "Scot" in the days before the Union Steam Ship Company and the Donald Currie Line amalgamated. It is not often that outside the North Atlantic an attempt has been made by steamships to compete, but the "Scot," of which we give a model, made some extraordinarily rapid voyages. On her trial trip she attained a speed of just under 19 knots, and her maiden voyage from Southampton to Capetown broke the record in 15 days 2 hours 10 minutes. I remember once seeing her in dry dock, and she had the lines and graceful symmetry of a yacht. Those were stirring days and she used to attract a tremendous amount of attention by her achievements. She was built in 1891, but five years later was taken to Belfast, docked, cut in two and lengthened fifty feet, her displacement tonnage increasing from 10,000 to 11,500.

The continuance of the keen rivalry in the Atlantic was shewn in the launching of the Cunard "Campania" in 1892 and her sister ship "Lucania" the following year. These two exceptional ships form a kind of bulkhead in our story, for they separate the age of the big

liner from that of the mammoths which were presently to come. As you regard this model you see a twin-screw, steel, triple-expansion ship built with plates of unprecedented size needing fewer rivets. In design she was handsome without being over-decked, her bridge is still a comparatively light scaffolding, she rises out of the sea dignified but not over-towering. All trace of the sailing age has disappeared from her. These two handsome sisters were the queens of the Mercantile Marine and they behaved charmingly. Speed and comfort and safety were their inspiration and their 22-knot gait enabled the " Campania " to rush across between Queenstown and New York in 5½ days : in fact, for a whole year's east-bound voyages she consistently kept up an average of just under 22 knots, and if that is not a fair test of a vessel what could be?

These sweet-lined, powerful ships had four decks, two pole masts, and their funnels were 130 feet from the bottom of the ship. They had been built under Admiralty supervision to be used, if needs be, as armed cruisers. The rudder and steering gear were, therefore, entirely under water so as to be protected from shell fire. It is difficult to see the rudder in the photograph, but this was another departure from custom, as it was a centre-fin plate and could be put hard over even when the ship was going at full speed. Although the " Campania," with her 21,920 tons displacement and her length of over 622 ft., was such an enormous ship for those days (though still smaller than the " Great Eastern "), she was exceptionally handy and would turn in her own length. The " Campania " and " Lucania " for years went on making marvellous passages, and it was their sensational and persistent success which caused the North German Lloyd to scrap their old-fashioned fleet and produce the " Kaiser William der Grosse," which by her mean speed of 22.81 knots did win for a time the " blue riband " of the Atlantic for Germany, the

first time in history. I have intentionally omitted from this volume a model of any German vessel. It is true that the North German Lloyd and Hamburg-America liners helped latterly very considerably to make the pace, but their "colossal," super-imposed, sky-scraping, tiering decks have not contributed to the beauty of ship development even if they are justifiable on other grounds.

But lest we should imagine that the Atlantic liners were the only notable vessels of the late 'nineties, the model of the Orient Steam Navigation Company's twin-screw "Omrah," comissioned in 1899, may be studied with advantage. This was a much smaller vessel of 507 ft. in length over all and a speed of 17 knots, but she was another of those Admiralty subsidised auxiliary cruisers employed in the mail service to Australia. Here we may leave the ships of the Merchant Service for a time and see how, whilst these had been developing into engineering wonders, the warships from the 'eighties had leapt from moderate-sized mobile batteries into stupendous steel fortresses of unparalleled devastating power and speed. It is only thus by sub-dividing our study that we can follow the curve of progress, and there-after we shall be in a position to see the ultimate evolution of the immense liner to-day.

And first let us see how the cruiser was to be modified under the influence of steam. From very early days of naval warfare small craft for the purposes of scouting, conveying intelligence and for commerce protection have been employed no less than the capital ship. In the hey-day of sail frigates, corvettes, sloops, and brigs were as requisite as the line-of-battle ship. The "Warrior" was a steam frigate but a costly transition-ship, and a return was made for a time to a smaller class of cruiser—the corvette—which, though possessed of steam power, could proceed under full sail. There were many experts who, while allowing that steam was essential for the capital ship of the

future, could not see that canvas would ever be banished from the lighter vessels. Protected cruisers on foreign service, where vast oceans had to be covered, could be worked economically and with a wide radius of endurance independent of the shore, if they could put out fires and let draw their sails.

But steam gradually displaced canvas even in these craft. Between 1870 and 1880 the Royal Navy built the "Iris" and "Mercury" with a speed of 18 knots, and these were the first two steel-constructed ships the British Admiralty ever commissioned. They were twin-screwed, lightly rigged, and then there grew up armoured cruisers well armoured and of good coal endurance. Two first-class cruisers were included in the naval programme of 1893-4, and thus we get vessels of 14,200 tons and a speed of 22 knots which was equal to that of the fastest liners. These were the two H.M.S. "Powerful" and "Terrible." Built of steel but having the hull covered with a sheathing, the "Powerful" could carry 5000 tons of coal. These were protected cruisers, and from this stage the type became armoured, the first of that class being the "Cressy," which was torpedoed and sunk in the first few weeks of the Great War. The "Iris" and "Mercury" were the forerunners of the "Leander" class of 1883, which had a protective deck over engines and boilers and magazines. Now in America the "Boston," "Atalanta" and "Chicago" were built in 1885-9, mainly on our "Leander" designs, and correspondence on this subject has been recently published.

In the United States these craft were known as the "squadron of evolution," which exactly describes their character in relation to development. They were also known as the "white squadron," and I have reproduced here a model of the white-hulled "Chicago." This was a protected cruiser of 5273 tons displacement, best known speed under steam 19 knots, and armed with four 8-in., fourteen 5-in. quick-

firers, and fourteen smaller quickfirers. The masts and yards are still retained, you will notice. This model is in the United States Naval Academy Museum.

That of H.M.S. " Powerful " is in the museum of the Royal Naval College, Greenwich. She was frankly a new departure in Admiralty practice and embodied many of the features which the fast ocean liners of her day had proved to be sound. She was a hundred feet longer than any previous British warship, and the model shews her as she was with her revised armament, consisting of two 9.2 in. (one forward and one aft), sixteen 6-in. quick-firers, fourteen 12-pdrs. and eight 3-pdrs. This vessel, with her 14,200 tons displacement, obtained a speed of 21.8 knots during her trials and in her, with the " Terrible," we have the " protected " cruiser at its best. She was designed to meet specially the threat of the Russian " Rurik " in order to protect our merchant ships along the trade routes. The " Powerful's " armament caused a certain amount of discussion, Sir John Fisher (then Controller at the Admiralty) and other experts preferring a uniform main armament of 6-inch guns. The weight of guns and their protection amounted to over 10 per cent. of the total displacement even then, but there was another school which believed that the 9.2 in. weapons were essential for her offensive power, and with the latter opinion the Board of Admiralty ultimately agreed.

The memorable Jubilee Naval Review of 1897 was considered by other nations as a demonstration of British sea-power, and regarded as a challenge. In the following year the Russian Admiralty undertook a special programme of naval construction, and in reply Mr Goschen, First Lord of the Admiralty, announced in the House of Commons that the Government intended to keep pace with anything that might be attempted abroad. Thus the growth of naval armaments was encouraged and the first-class " armoured " cruisers of the

" Drake " class were designed. These were the " Drake," " Good Hope " (afterwards to be Admiral Craddock's flagship sunk at the Battle of Coronel), and the " Leviathan." These were of 14,000 tons, armed with two 9.2-in., sixteen 6-in., fourteen 3-in. and several smaller guns. The model of " Leviathan " is in the Greenwich collection, and her best speed was just over 24 knots. At the beginning of the Great War in August 1914 she was ordered into the Atlantic to look out for enemy cruisers and colliers, and was then employed for a time in escorting transports bringing troops to Europe from South Africa. Thus, she did actually perform the identical work for which she had been designed.

With the " Powerful " and the " Leviathan " should be compared the protected cruiser " Adventure " of 1905 in order to see how gradually and beautifully the cruiser from the time of the steam frigates and corvettes became transformed into the very expression of speed. Lithe and slim as a greyhound, graceful as a deer, with curves as sweet as those of a gull, the " Adventure " and her sister the " Attentive " were two of the prettiest ships which ever flew the White Ensign. The model of the former here reproduced is in the Royal Naval Museum at Greenwich also. The intention of their design, speed and armament was for employment as scouts—as the eyes of the fleet—though for this purpose they had been surpassed by the bigger and better-armed " Town-class " light cruisers by the time the war actually came, and were used for other purposes. The " Adventure," for example, spent most of the war at Queenstown as the flagship of the commander-in-chief, Admiral Sir Lewis Bayly, and in some of those winter Atlantic gales off the south-west Irish coast she was sometimes tried severely and got back to port with her boats smashed after being thoroughly washed down by the heavy seas. There was at least one U-boat whom she terrified into submersion and

thus saved a valuable torpedoed Leyland liner that managed to reach safety.

The " Adventure's " dimensions were 29,400 tons displacement, speed 25 knots, her original armament being ten 3-in. (afterwards nine 4-in.), eight small other quick-firing guns and two torpedo tubes. But you will be able to see in the model of H.M.S. " Glasgow " how the protected cruiser was pushed still further towards perfection along these lines. Here is a vessel which cost £312,000 to build; but if you reckon up her career she would have been cheap at three times the price, for apart from her other fine work during the war she was present at two of the most famous battles of modern naval history—Coronel and Falklands—and she eventually had the good fortune of rounding up and witnessing the sinking of the German cruiser " Dresden," which had escaped after the Falklands battle. In regarding this model, then, we are considering an historical ship, so we may stop for a moment to examine her in detail. Her dimensions are—length 430 ft., beam 47 ft., displacement 4800 tons, speed 25 knots. Forward she mounts one 6-in. and aft she mounts another, but on each broadside you will notice also five 4-in. guns. It is the office of a cruiser, when working with a fleet or squadron, to search out the enemy and keep the admiral informed of the enemy's ships, numbers, bearing, distance, etc. Hence one reason for the cruiser's speed. She was never intended to lie in line of battle or she would have been more heavily armed.

Now, immediately prior to the battle of Coronel, the " Glasgow " was despatched by Admiral Craddock to the northward, picked up the " Leipzig's " call-sign by wireless, was ordered to get into touch with von Spee's squadron, and it was she who on that fateful afternoon of November 1 was the first to sight the German smoke, and as soon as she had made out the enemy, steamed back at full speed towards

Admiral Craddock's flagship, "Good Hope." As you look at this model you can picture the "Glasgow" in the failing light and dirty weather, rain squalls and heavy seas breaking over her bows, being straddled by the enemy's shells and in turn stabbing the afterglow with her own 6-in. and 4-in. fire; then being hit by a 4.1-in. shell from either the "Dresden" or the "Leipzig" at the waterline over the port wing screw (for she had four propellers), and having her quarter there stove in as if she had been rammed. Whenever the "Glasgow's" guns flashed, as the "Good Hope" burnt, she received the concentrated attention of the enemy's fire. How the "Glasgow" escaped from that battle is a marvel. Six hundred shells were fired at her, of which five had hit her on the water-line, but the coal protection had saved her. After that disaster she managed to get away, her speed helped her, and a week later she reached the Falklands, and a month later still it was she, whilst in Port Stanley that memorable morning, who took in the signal that von Spee's squadron was approaching, raised steam and as soon as ready put to sea.

During the chase by Admiral Sturdee's squadron of Admiral von Spee, the "Glasgow" again fulfilled her cruiser role by signalling hour after hour the enemy's movements and distance and speed. Here her speed was to be invaluable once more and she was able to get ahead and attack the "Leipzig," receiving in turn two hits, and presently, with the armoured cruiser "Cornwall," deluged the "Leipzig" with the "Glasgow's" broadside. Finally, the "Leipzig" was doomed and that night sank, largely owing to the "Glasgow's" splendid efforts. Thus this beautiful protected cruiser justified her existence many times over even if we omit all the rest of her work during the war, such as hunting for German raiders in the South Atlantic and protecting our trade routes there. It is one of

the aims of this present volume that it may form an illustrated commentary on naval history of the last hundred years, and if we can have before our eyes these lively models, we are able to conjure up afresh the very incidents we have been invited to study.

Now that we have seen the evolution of the cruiser up to the Great War, let us go back and continue the development of the capital ship. From 1859-1874 the wrought iron armour underwent no change, but improved machinery enabled thicker plates to be rolled as time went on. The " Warrior's " armour plates were only 4½ inches thick, the " Devastation " of 1869 had 14 inches, the " Inflexible " had two thicknesses of 12 inches, but the outer thickness of her turret armour was compound or steel-faced. The object of this hard face was in order to break up the projectiles on striking, and this armour was continued up to and including the eight vessels of the " Royal Sovereign " class. The model of H.M.S. " Victoria " of 1887 is in the South Kensington collection and this battleship is remembered because of one of the greatest naval disasters which ever happened during time of peace. Commander John Rushworth Jellicoe was serving in her, but happily he was one of the survivors and lived to be commander-in-chief of the British fleet at Jutland many years after. Another model of this ship, exquisitely wrought of silver, is in the vestibule of Windsor Castle, and by His Majesty' gracious permission I was recently permitted to examine it there.

The " Victoria " was a single-turret battleship of Jubilee year, with armour of from 16 to 18-in. thick and a protective deck. She was twin-screwed, of 10,470 tons displacement and a speed of 17¼ knots. Her armament consisted of two 111-ton guns, one of 29 tons, and others of smaller calibre, and among her boats she carried a small torpedo-boat. We had now reached the stage when water-tight compartments, steel-faced armour, breech-loading guns and the ram

were characteristics of the ship fit to lie in line of battle—or simply "battleship," as she was now designated for a long time past. It was the "Camperdown's" ram which, on June 23, 1893, off the coast of Syria, sent the "Victoria" to the bottom together with over three hundred officers and men. Originally the "Victoria" was called the "Renown," but just before her launch the name was changed. She was a great lump of a ship but she had to carry that enormous weight of those two big guns in the forward turret, and even in smooth water when steaming at full speed she threw up a bow wave as high as the upper deck. The result was that had such a ship as this been driven at top speed head on to a big sea—such as in the Battle of Coronel—the efficient fighting of that forward turret would have been impossible. I remember this ship well as a boy, and when one thinks of the modern men-of-war with their thirty feet of freeboard, it does seem extraordinary that the influence of the old low-lying "Monitor" should have lasted so long.

The protection of the water-line was by a narrow belt of vertical armour extending over only a portion of the length, and it was the unarmoured end of the "Victoria" that suffered the injury which sent her to the bottom in thirteen minutes; for the "Camperdown's" ram struck her on the starboard bow, which is here well seen, about ten feet abaft the anchor. It came right through the ship as far as the chain locker and burst in the bulkhead. The "Victoria" then settled by the bow and heeled to starboard, next gave a lurch, fell over on her side, turned bottom up and finally sank at an angle of twenty or thirty degrees to the vertical. This disaster caused tremendous controversy, but the Court Martial held at Malta did not feel itself competent to express an opinion as to the causes of the capsizing. Naval architects, however, did; and we know that it was the admission of water to the superstructure through open doors that made the "Victoria"

lose her stability and capsize as she was settling down. There was no continuous, central, longitudinal bulkhead in the forward part of this ship. The lurch began when the water rapidly entered through the armour door and the broadside gun ports, and had these been closed and the entry of water into the upper deck battery thus prevented, the ship would not have capsized. That, at least, was the opinion of the architectural experts at the Admiralty, as opposed to those who criticised the absence of protective deck.

The " Royal Sovereign " class, as shewn in the Greenwich model, were distinct improvements on the " Victoria " and her sisters. Built in 1891, this was a twin-screw battleship of 14,150 tons, and the increase in tonnage was due not merely to extending the vertical armour, but to increase of speed, number of guns and in the height of the latter above the water. This was an important point. In these ships 18-in. armour was employed for the belt and 17-in. for the barbettes. Nickel steel was employed for part of the side protection above the main 18-in. belt. Naval tacticians preferred power concentrated in one single 14,000 ton ship rather than in several smaller: on the other hand, there was always the objection that she afforded a bigger target for the enemy. But the " Royal Sovereign " and her seven sisters were very much admired by contemporary naval officers, one distinguished officer calling her " the most beautiful ironclad to look on I have ever seen, but would look better without the stern-walk. . . However, it is too necessary for an Admiral to be abolished."

The " Royal Sovereign " had a speed of 18 knots, two 13.5 in. guns forward, two aft, and five 6-in. guns on each broadside. These details will be recognised in the model. The fighting masts and tops, derricks for swinging in and out the boats, the addition of an after bridge—all such features shew the advance made since the age of

canvas. But this high-freeboard, barbette battleship was to have an influence outside her own sphere. For the naval victories of Japan over the forces of China, and the former's remarkable development as a naval power reacted on ourselves who had, ever since the 'eighties, done so much for the design and construction of Japanese warships, Thus, in 1897 and 1899 respectively, were built the "Fuji" and "Shikishima" in British private yards, which were modified "Royal Sovereigns," and you will be able from the model of the "Shikishima" to compare this similarity. The latter's details were—14,850 tons, 18 knots speed, four 12-in. guns, fourteen 6-in. quick-firers, and others of smaller calibre. The protection and disposition of the "Shikishima's" 6-in. guns followed the "Royal Sovereign," as was the disposition of the armour. The addition of two such powerful vessels, ranking with the first-class battleships of Europe, suggested possibilities with regard to the numbers and types of British warships, especially in Eastern waters.

These two British-built ships were in the Japanese First Squadron in their well-known victory over the Russian Fleet at the Battle of Tsu-Shima, May 27, 1905, and largely contributed to the success. In 1906, therefore, we find Sir W. G. Armstrong, Whitworth & Co. building for the Japanese Navy the 16,400-ton battleship "Kashima," armed with four 12-in., four 10-in., twelve 6-in., and a number of smaller guns. The two photographs, by the courtesy of her builders, are of the "Kashima's" model, which was presented to the Japanese Crown Prince during his recent visit to England, and shews how the contemporary British "King Edward VII." and "Lord Nelson" type of battleship was to influence the future Japanese building design. The model of the Japanese battleship "Aki" in the Greenwich collection represents the enormous adaptability of that nation, since the ship herself was built at Kure Navy Yard, Japan, in 1907-10.

The model shews her with her torpedo-nets out, and this vessel of 19,780 tons and 20½ knots, had for her armament four 12-in., twelve 10-in. (arranged in pairs, as will be noticed), eight 6-in. and some smaller guns.

It was in 1907 that the " Dreadnought " inaugurated an entirely new departure in our own Navy and in all the navies of the world. Every one knows that this was largely due to the sagacity and energy of the late Lord Fisher. It was in its broad conception comparable to the improvements which had been proceeding in the Mercantile shipping. The immediate predecessors of the " Dreadnought " were the " King Edward " and the two " Lord Nelsons," and the heaviest main armament had been four 12-in. guns; but the coming of the " Dreadnought " at once established an entirely new standard by mounting ten of these. She was full of so many fresh ideas, she concentrated in her so much scientific and engineering knowledge, summing up all that had been learnt since the advent of the steam and metal age that we can but point to the outstanding features of this epoch-making battleship. In a word, she represents the triumph of the all-big-gun idea, but she was bigger also in displacement and of greater speed, and cost as well. The following are the statistics: 17,900 tons compared with the 16,500 of the " Lord Nelson," 21 knots speed, all obtained at a cost of nearly two millions sterling. It was a bold policy.

Her midship section was protected with Krupp steel of about eleven inches thick, this being equal to about twenty inches of the old compound armour that we were discussing. As everyone is aware, the " Dreadnought " type went on developing and becoming more powerful, so that at Jutland all Admiral Jellicoe's twenty-four battleships were of this class. As an instance of the effect which this new policy had on other navies, I have thought well to introduce here

a model of the extremely interesting "Minas Geraes," which was built for Brazil. She is more nearly like our later Dreadnoughts, the "St. Vincent" class, with her 19,250 tons, but she is more heavily armed, for you will observe two pairs of super-imposed guns both forward and aft, another pair on the port side, and there is a corresponding pair on the starboard—a total of twelve 12-in. guns, though our "St. Vincents" carried only ten guns of this calibre. The "Minas Geraes'" speed is over 21 knots, and her secondary armament is twenty-two 4.7-in. quick-firers, and her belt armour was nine inches. This British-built battleship with her tripod mast, her fire-control, searchlight platform and a thousand other gadgets shews the finest achievement of warship building in 1910—an almost incredible transformation which a century's engineering had brought about.

But consider the improved British Dreadnought "Monarch" of 1912, which, with her three sisters, introduced that stupendous armament of ten 13.5-in. guns. What a terribly long way it seems since the propeller was actually fitted to a three-decked wooden wall! The "Monarch" of the "Orion" class is a super-Dreadnought of 22,680 tons, and 21 knots. Turbines, balance rudders, quadruple screws, wireless, 12-in. belt armour—what a wonderful thing the capital ship has become! But we are tracing it just as far as the Battle of Jutland, so we include from the Imperial War Museum the model of the "Canada," which is even more recent still. Here we have a ship that was being built at Elswick when the war broke out. She had been constructed for the Chilean Navy and was named the "Almirante Latorre." Having ten 14-in. guns, twin-mounted, as you will see, on the centre line (and thus all of them able to fire on either broadside), she was an exceedingly valuable unit for the British Government to take over, and it shews how useful it is to have private yards with warships ready to be commissioned in case of emergency.

In most of her features this battleship was similar to our super-Dreadnoughts, though the main armament was heavier, and the secondary armament of twenty-two 4.7-in. guns were changed to sixteen 6-in. The "Canada's" protection was rather lighter than our own battleships, but her speed of $22\frac{3}{4}$ knots was a little superior, and this nominal speed was considerably exceeded on trial. The vessel was taken over by the British Admiralty in September 1914 and completed a year later. It was the "Monarch" which, during the dark hours preceding daylight early in December of 1914, was steaming with Admiral Jellicoe's fleet, all lights out, into Scapa Flow when she suddenly sighted under her bows a patrol trawler, so altered her course and stopped. Astern was following the battleship "Conqueror," who was unable to avoid a collision, crashed into the "Monarch's" stern, both ships becoming badly damaged and rendered unseaworthy just at a time when the fleet could ill afford to be weakened. The "Monarch" was sent to be repaired at Devonport and was back at Scapa before the end of January.

At the Battle of Jutland she was in Admiral Leveson's division. The "Canada" had first joined the Grand Fleet in the middle of October 1915, and at Jutland was with the "Iron Duke," "Royal Oak" and "Superb" in the third division. And we are luckily able to end this section of our study with two exceptional Jutland-ship models of the greatest beauty and finest work. These are respectively the two battle-cruisers "Indomitable" and the "Queen Mary." Of all the models in this volume which could be more interesting in craftmanship and for the history which is attached to their names?

The "Indomitable" and "Inflexible" were the first battle-cruisers to be built and this was in 1908. They were known originally as "battleship cruisers," for they had the fighting power of the

former and the speed of the latter. They were something entirely new, something quite different in the history of the warship, and were one of the results of the Dreadnought policy. They were most costly to build, the "Indomitable" being £1,761,080, and the "Queen Mary" £2,061,064. The particulars of the former are: 17,250 tons, speed 28 knots, armed as you will see with eight 12-in. guns. The "Indomitable's" model becomes still more interesting when we remember that it was this vessel which was in touch with and shadowing the German battle-cruiser "Goeben" on August 4, 1914, but the latter had the superior speed. "Indomitable" was present at the Battle of the Dogger Bank on January 24, 1915, when the "Blucher" was sunk, and it was the "Indomitable" who, after Admiral Beatty's battle-cruiser "Lion" had been damaged, took her in tow. At the Battle of Jutland the "Indomitable" was with the "Inflexible" and "Invincible" battle-cruisers under Admiral Hood. The "Invincible" was sunk and Admiral Hood in her, but the "Indomitable" not merely did excellent work but survived. This model is here reproduced by the courtesy of her builders, the Fairfield Shipbuilding & Engineering Co., who must have felt no little pride when Admiral Beatty in his despatch on the Dogger Bank action reported that she greatly exceeded her normal speed.

The "Queen Mary" was a 27,000-ton ship of 30 knots, but armed with eight 13.5-in. guns, one of the forward turrets being superimposed over the other. She was, therefore, a most valuable unit, and as efficient as she was beautiful to behold. This model's illustration has been lent to me by her builders, Messrs Palmers' Shipbuilding and Iron Co., though the model itself was presented by them to Her Majesty Queen Mary. It measures 14 ft. 4 in. long and is of the scale one inch equals four feet. Launched in 1912, you will see that she had twin balanced rudders and quadruple screws. During the war

she performed a long list of useful services until her disastrous end. She was in action off Heligoland on August 28—an engagement that we now know had a deep effect on the enemy right throughout the war. She was afterwards sent for a spell of special service in the Atlantic, she was away refitting at the time of the Dogger Bank action, but was one of Admiral Beatty's most important units in his battle-cruiser fleet at Jutland. It was a salvo fired from one of the German battle-cruisers which hit the "Queen" abreast of "Q" turret, and she blew up in a dense cloud of smoke, only a few survivors being picked up. This illustration will, therefore, have an additional if pathetic interest.

Now that we have seen the big capital ship, the battle-cruisers and cruisers develop from the primitive steam age soon after the Battle of Trafalgar, and have traced them right to the Battle of Jutland, let us, before passing on to the corresponding great ships of the Mercantile Marine, stop to see something of those interesting smaller steam craft, the torpedo-boat and torpedo-boat destroyer. The latter is the more modern of the two and has gone on growing until to-day; with her super-imposed guns and her tremendous displacement, she is more correctly a second-class cruiser. The introduction of the Whitehead torpedo at once introduced new tactics into naval warfare, and suggested a small steam craft of great speed so that she could discharge her torpedo yet be under fire of the big ships' guns for the minimum time. The first conception was to design a steamboat of about eighty feet long, and in 1877 Russia built a hundred boats 75 ft. in length, which could be transported by rail from the Baltic to the Black Sea.

But the first torpedo-boat to be constructed for the British Navy was in 1876 by Messrs John I. Thornycroft & Co., and this was named the "Lightning." The builders' model here shews this little vessel. They had already in 1873 constructed a steel launch for the

Norwegian Navy, but the "Lightning," which measured 84 ft. 6in. in length, 10 ft. 10in. beam and 5 ft. in depth, was the mother of all our numerous flotillas. She was made for independent harbour or coastal service and had a speed of 18 knots, the hull being of galvanised steel. The conning-tower forward of the wheel contained the engine-room telegraphs and the firing gear for the torpedoes and also steering gear. Amidships on either side will be seen a 14-in. Whitehead torpedo on its carriage, discharge being by means of compressed air through the conspicuous tube at the bows.

We have seen in the model of H.M.S. "Victoria" of 1887 that small torpedo-boats were at one time carried aboard big ships, but before long the torpedo-boat was to become something bigger than a mere clever toy. Most of the other navies of the world soon had these craft built, and, besides Messrs Thornycroft, the two firms of Messrs Yarrow & Co. and Messrs J. Samuel White & Co. have specialised in their evolution, though there are very few yards in the country which have not at one time built these vessels. With the Continental powers the popularity of the torpedo-boat was similar to that later on of the submarine. They were cheap, deadly, and (especially in France) started the fallacy that the battleship was doomed.

But the torpedo-boats were already growing in numbers and size; and Yarrows constructed one of 100 ft., which steamed on her own bottom out to the Black Sea. Years ago I was talking with the son of a well-known poet who had done many interesting things, but few experiences were more entertaining than his story of how he took across the Atlantic the first torpedo-boat that ever made the voyage. Messrs Thornycroft built a 147 ft. torpedo-boat of 26 knots for the French Navy, but already the British Admiralty had begun to use some of 125 ft., carrying five torpedoes. It was now just a matter of increasing the length and displacement of these craft to make them

thoroughly seaworthy and dependable. Those were the days when Anglo-French relations were apt to become a little strained every now and again, and we were not worrying yet much about Germany. It was because of the French torpedo-boats that the British Admiralty devised a counter vessel known as the torpedo-boat destroyer. Similarly, the French in 1882-3 built the " Bombe " and " Condor " classes which were spoken of by the naval architects at the British Admiralty as " torpedo destroyers," and this was probably the earliest use of the term. The " Bombe " class were 180 ft. long, 350 tons, speed 17 knots. Yarrows were building a large twin-screw 166 ft. torpedo-boat, which was sent out in sections to Japan, put together, and named the " Kotaka." It was she who led the flotilla which entered Port Arthur during the Chino-Japanese war.

In England the reply to the French destroyer " Condor " of 216 ft. and 1300 tons—a torpedo gunboat—was to build the " Scout " and other ships. Germany, France, Japan, Austria were all wanting torpedo craft and coming to British yards to have them built. Thus once more private shipyards were encouraged to the great benefit of naval architecture and constructional progress.

The model of the Russian destroyer " Sokol," built by Yarrows in 1895, illustrated the trend in advance, for you have here a slim craft of the maximum speed with the minimum displacement. She was a 240-ton vessel, 190 ft. long, the hull of nickel steel, aluminium being used for many of the fittings in order to decrease the weight. She drew only seven feet but she developed a speed of 30 knots, which made her the fastest steamer afloat. For armament you will notice the 12-pdr. forward; there were also three 6-pdrs. on deck, and two swivel tubes for discharging 16-in. torpedoes. That was the line along which the anti-torpedo craft was growing.

During the years 1885 to 1889 we built forty-five torpedo-boats

of only sixty to 125 tons, but between 1893 and 1903 the British Admiralty launched twenty-three torpedo-boats of between 112 and 205 tons, though by the time the Great War arrived these were obsolete and some were used for patrolling off harbours, or inside the Isle of Wight or in estuaries. In 1906-8 thirty-six more were built of bigger tonnage and more improved design. It is an open secret now that they were intended for employment up German rivers, but by the time the war arrived they had been outclassed by destroyers and were used for coastal patrol work and local defence. We had long since given up building any more torpedo-boats.

This batch consisted of Nos. 1-12 and 13 to 36. I have included here a model of T.B. 17, built in 1907. The particulars are 180 ft. long, 18 ft. beam, 251 tons displacement, speed 26 knots. She is practically a modern destroyer in embryo, with a 12-pdr. forward, one aft and three 18-in. torpedo tubes. The capstan was hand-worked, and although she had three shafts, it was only the middle one that could be used for going astern, the other two being used solely for going ahead. Consequently, during the early days of the war when these pretty little craft used to come in from their North Sea patrol into a crowded harbour and berth themselves, one would often see some amusing bits of seamanship. But for a young lieutenant what a delightful command these craft were, and what splendid training ships for future destroyer captains! The canvas screens on and just below the bridge are not shewn in the model, but you can see the wheel, compass and searchlight. These "oily-wads," as they were nick-named, were at the Dardanelles and several theatres of war, but they are now obsolete.

Compare her, if you please, with the model of her contemporary destroyer, the "Viking" of 280 ft. length and 1050 tons, first commissioned in the spring of 1910. She was one of the "Tribal"

class, and you will notice the built-up fo'csle, and the stern such as used for fast motor boats as the ship settled down aft when at high speed. This model is owned by Messrs Palmers' Shipbuilding and Iron Co., who constructed the ship of a special high tensile strength steel. Driven by turbines, she had three propeller shafts and six boilers—each boiler having its own funnel. Both forward and aft you will see a 4-in. gun, and she had a couple of 18-in. tubes. She was oil-fuelled and carried a bunker capacity for 100 tons. This destroyer did a speed of nearly 34 knots on trials, but the drawback to her type was that the fo'csle was so short, and, therefore, when proceeding at high speed in a seaway she was very wet forward, and thus the gunnery would be hindered.

But the "Viking" did uncommonly well during the war. In the autumn of 1914 she was based on Dover guarding the Straits, and was one of the British force operating in October off the Belgian coast in the effort to aid our armies by stopping the German advance. Here the "Viking" had the bad luck to be injured by the bursting of one of her 4-in. guns, but that misfortune was only temporary, and with Commander E. R. G. R. Evans (of Antarctic fame) as her captain she helped to make the Dover Straits unhealthy for submarines, finally with the aid of her tribal sisters, "Gurkha" and "Maori" sinking U 8 on March 4, 1915.

The model of the destroyer "Grasshopper," by the Fairfield Shipbuilding & Engineering Co., is a smaller type of 950 tons but launched in 1909. She is triple-screwed with a speed of over 27 knots. Her armament shewn consists of one 4-in. and three 12-pdrs. and two tubes. Notice that, as in the "Viking," hand-steering gear—in this case double—is arranged aft, in case the bridge were shot away. It was only after the next class which followed this that hand-steering aft was done away with. She was one of the "Beagle" class and

burned not oil but coal. The " Grasshopper " did good work during the war, and at the Dardanelles was one of those destroyers which endeavoured to protect our trawlers whilst mine sweeping towards Kephez under the enemy's searchlights and hellish fire; and she also supported the famous landing at Gallipoli on April 25, 1915.

But the coloured illustration of the model " Broke " shews one of the most famous ships of the war and heroine of as gallant and brilliant minor action as you will find in naval history. She is, strictly speaking, a flotilla-leader or big destroyer, her dimensions being 1700 tons displacement, 320 ft. long, 32.6 ft. beam, with 11 ft. draught. Triple-screwed, with a speed of 31½ knots, she was being built in 1914 by Messrs J. Samuel White & Co. at Cowes as the " Almirante Goni " for the Chilean Navy. The British Admiralty took her over, but after the war she was sold to South America. Her armament was a little unusual—six 4-in. quick-firers placed as will be seen, two on the foc'sle abreast of each other, one each side at the break of the foc'sle, and two more on a raised platform aft. In addition, she had a 1½-pdr. and four tubes. On this model are shewn the two search-light platforms and direction-finders. No one with an eye for a pretty ship could fail to admire her, and though she has passed to serve under another flag she will not be forgotten.

This flotilla leader has actually 30,000 horse power. There are three outstanding incidents of her war-time career, which should be noted. In the first December of the war during battle exercises she collided with the light cruiser " Bellona " and was seriously damaged. At the Battle of Jutland she was leader of her half-flotilla, and half an hour before midnight sighted and attacked German cruisers which were retreating to the south-east. The "Broke" received injury to her steering gear which in turn caused her to ram a British destroyer so badly that the latter had to be abandoned in the morning. Some

anxiety after the battle was caused by the " Broke " not returning to harbour, but eventually in her damaged condition she got through bad weather and reached the Tyne. But in the following spring the " Broke " was commanded by Commander E. R. G. R. Evans, late of the " Viking," and placed in the Dover patrol; and it was on the night of April 20-21 that she and the flotilla-leader " Swift " encountered along the barrage a division of German destroyers. The engagement that followed is too well known to need repeating. You will remember the hot fire that was exchanged and how the " Broke " deliberately rammed one enemy destroyer and then completed the destruction of the second, and when you read that incident again and of the hand-to-hand fight on the " Broke's " foc'sle, you may find it quite helpful to have this model photograph in front of you.

The Yarrow-built, two-funnelled destroyer shews one of the " Firedrake " type which were so busily employed during the war. She is not as long as the " Broke," but with her 267 ft. she has a speed of 39 knots, and she is armed with three 4-in. guns and two double torpedo tubes. Notice that the foc'sle is much more convenient in a seaway than that of, say, the " Viking." The Thornycroft three-funnelled destroyer " Mastiff " was one of the early M-class at the beginning of the war, her details being 275½ ft. long, 27½ ft. beam, depth 10½ ft., 946 tons displacement, armed similarly to the Yarrow ship, using turbines and oil fuel. Early in the war I came down the North Sea in one of these M-class destroyers fresh out of the builders' hands, and the experience of getting from the Humber to the Solent in such few hours is unforgettable. The "Teazer" is another Thornycroft destroyer but of later type. In 1917 she was one of Commodore Tyrwhitt's famous Harwich force. Here the destroyer has become almost a light cruiser, for the " Teazer " measures 274 ft. in length, her displacement is 1034 tons, and she develops 29,000 horse power.

With her speed of 35 knots, three 4-in. and two 2-pdr. guns, her paravanes, and her forefoot specially designed for ramming submarines, she represents the destroyer practically at her peak of progress.

But it is in the two flotilla-leaders " Shakespeare " and " Spenser " (see Plate 1) of 1917 that we see how slight is the resemblance to the original " Lightning " of forty years ago. These two fascinating models, of which the coloured one will give you even a more vivid idea as to these exquisite ships' appearance, represent each 1750 tons displacement, 43,500 horse power, and a speed of over 36 knots. They are 329 ft. in length, armed with five 4.7-in. guns and one 2-pdr. anti-aircraft. Observe that as in the recent light cruisers, the guns forward and aft are super-imposed. Range-finders, director-firing, and many other features, too numerous to mention, make these warships fascinating to any one who really loves the romance of the sea.

Finally, reverting to the pure destroyer type, we have in H.M.S. " Tobago " and " Wishart " two more Thornycroft vessels of the post-war period. Let us take the " Tobago " first. She is in some respects similar to the " Broke's " design with her rounded forefoot. Her foc'sle is high and long, with a nice sheer, giving the 4-in. forward gun every protection from the sea. The second 4-in. is amidships, the third is aft, and all three have gunshields. A Carley float—so useful during the war—is seen at the base of the forward funnel, and the range-finder aft, like the searchlight, has a platform to itself. This is a 1087-ton ship with a speed of 36 knots. I have been to sea since the war for days with a division of this " S "-class, and from the bridge of a flotilla-leader single-line ahead, steaming out of a February haze round Portland Bill into Portland Harbour they all looked real little men ready for big jobs. The " Wishart," with her four super-imposed 4.7-in. guns, sharp forefoot and 312 ft. of length, is a bigger ship, displacing 1345 tons and possessed of 35-knot speed. And here

we must leave the torpedo craft in their prime to go back and see how the big merchant steamship has been affected all this time.

And it will be convenient to divide these commercial ships into the following classes, in order that we may see the development according to the particular requirements. First, we shall take the so-called intermediate ships; that is to say, passenger liners not exceeding 21,000 tons and not of the utmost speed. From regarding these we shall be in a better position to consider the mammoth class with her exceptional speed. In this section we shall reach the climax of the merchant steamship, and then we shall pass to see something of the special types of smaller vessels—the fast cross-Channel craft, the shallow-draught craft for abroad, ferry steamers, tugs, trawlers, tank steamers, ice-breakers, and steam yachts.

The Cunard "Caronia," a twin-screw vessel of 19,687 tons, 650 ft. long, with quadruple-expansion engines of the reciprocating type, shews the tiers of decks beginning now to rise. She has eight of these, the height from the boat deck to waterline being eighty feet. But she was built for comfort, steadiness in a seaway, strength, and of moderate speed. The "Royal George" was originally built for the express service between Marseilles and Alexandria, but was then modified for Atlantic service and ran from Bristol to Canada. She was afterwards taken over by the Cunard Company, though she was of a type different from their usual ships.

The "Empress of Russia" and her sister ship "Empress of Asia," built by the Fairfield Shipbuilding & Engineering Co. for the Canadian Pacific Railway in 1913, are exceptional ships. They have the cruiser stern which had been developed in vessels of the Royal Navy, balanced rudder, turbines, and quadruple screws, and a speed of 21 knots. We have here in this three-funnelled type of 16,700 gross tons and 592 ft. length two of the handsomest vessels which ever sailed

the seas. During the war they were of great assistance to the British Navy in the Far East as armed merchant cruisers. Before the end of August 1914 both ships had been taken over and armed. There was some difficulty in getting enough crew for these two, but besides the R.N.R. men the full numbers were actually made up of R.G.A. soldiers, men from French Yangtsc gunboats, and Pathan sepoys. After the fall of Tsingtau, the " Empress of Asia " was employed escorting transports of our Far Eastern garrisons westward and patrolling the Indian Ocean for the elusive " Emden," as was the " Empress of Russia." And it was the latter which met H.M.S. " Sydney " after the sinking of the "Emden" in the Cocos group and took over the German prisoners. In every respect these two ships made ideal auxiliary cruisers.

The " Narkunda " is another cruiser-stern liner built by Harland & Wolff in 1920 for the P. & O. Line. She is a vessel of 16,227 tons, 581 ft. long, with three funnels and triple-expansion engines. The Suez Canal has always had necessarily the effect of moderating the draught of eastern shipping, and thus the Atlantic type of ship with tremendous top-hamper and immense displacement will never be suitable for this service. The " Cameronia," another post-war ship, built in 1920 by Messrs William Beardmore & Co. for the Anchor Line, is a 552 ft. vessel but of 16,365 tons, with cruiser stern and six turbines geared to twin-screws. The utmost speed is not required, but the highest efficiency in a large ship of not excessive size.

The model of the cruiser-stern " Arundel Castle," of 19,023 tons, built by Messrs Harland & Wolff in 1921, is an extremely handsome vessel with her familiar red funnels and purple grey hull. She measures over 630 ft. in length and is the first Union-Castle liner to have turbines. These are four in number, geared to twin-screws. The " Volendam " of 15,434 tons is another cruiser-stern Harland &

Wolff ship with four turbines geared to twin-screws, but she is of 550 ft. long and has water-tube boilers. She was constructed in 1922 for the Holland-America Line, and there is an absence of multi-tiered decks in this modern vessel.

The models of the " Conte Rosso " and " Conte Verde," though owned in Italy and registered at Genoa, were British built by Messrs William Beardmore as recently as 1922, for passenger and cargo service between Italy and both South and North America. They are twin-screw ships of 18,017 tons, driven by two sets of compound steam turbines, each set consisting of one high pressure and one low pressure turbine and driving through double reduction gearing a common gear wheel mounted on the propeller shaft. These ships are each 570 ft. long and have a service speed of 18½ knots, and must be reckoned as two of the most important post-war liners afloat. Notice the shape of the stern and rudder which should be compared with that of the mammoth Cunarders to be mentioned presently.

The Orient liner " Orama " at the moment of writing is not even launched, but her model has recently been made and is here reproduced by the courtesy of the owners. This interesting coloured picture shews the 20,000-ton modern liner of 632 ft. length and six turbines geared to twin-screws. The " Mongolia," built by Messrs Sir W. G. Armstrong, Whitworth & Co. last year, is a smaller vessel with six geared turbines and two shafts, but she is 551½ ft. long and of 16,385 tons. To the same year belongs the P. & O. cruiser-stern, 20,700 ton " Mooltan," built by Messrs Harland & Wolff. She is 600 ft. long, with twin-screws.

Representative of the most modern type of smaller liners are the models of the 7800-ton Elder Dempster " Abosso " and the 11,200-ton Aberdeen Line " Themistocles," both Harland & Wolff built. The colour illustration of the " Ohio " shews the latest Royal Mail

liner, built in 1923, with twin-screws and a length of 590 ft. This vessel is of 18,940 tons, but as you look down on her decks you seem almost to have the view of a town from an aeroplane with so many erections and houses, yet the triumph of the shipbuilder and naval architect is such that in this, as in even the mammoth ships, the liner, besides giving passengers the luxury of the shore, has to endure such strains and stresses that no mansion on land is ever subjected to, and all the time preserve that beauty and symmetry of form, that series of curves and sweet lines which belong to craft whether sail or steam.

The principles governing the design of any merchant ship are influenced firstly by the amount of merchandise and passengers she is to carry, and secondly by the speed at which she can be economically propelled. Is she to do a week's fast Atlantic run or a much longer and slower voyage with no intervening port where to fuel? There are so many conflicting points to be dove-tailed in that in the end the ship is like life itself, a wonderful compromise. In the case of the fast ocean passenger liner type we have one of the most specialised instances of naval architecture. The progress during the years immediately preceding the war were without precedent. From 1914 to 1918 this advance was stifled, and then came the slump in shipping which still further arrested the development of the very biggest ships, owners preferring to build economically.

But the mammoth ship age had been inaugurated before the war and the set of models which here illustrate this unique type deserve the greatest attention, for in years to come they will be of the utmost value historically. The first two vessels of the " Mammoth " type to be built were the Cunard " Mauretania " and " Lusitania." The latter was sunk by a German submarine in May 1915, but the former is still with us. In the North Atlantic trade there is no restraining influence such as the Suez Canal, but dock and harbour accommoda-

tion can alone prevent the 1000-ft. liner from at last becoming a reality. The " Mauretania " took five years to build and some most important and interesting points had to be dealt with in her construction, Sir William White, who had been the Chief Constructor at the Admiralty, being temporarily associated with Messrs Swan & Hunter until she was completed. She was thus the product of the finest brains in the country. She was designed in 1903, launched in 1906 and ready for sea in 1908. The dimensions—762 ft. long, beam 88 ft., and draught 36.25 ft., with 41,590 tons displacement and a speed of 25 knots—were staggering and made all previous accomplishments seem quite ordinary. The building of the " Great Eastern " was nothing in comparison, but it was the financial agreement between the Cunard Company and the British Government that made this undertaking possible, and we know how invaluable a transport she was during the war.

The agreement had insisted that these two ships should be "capable of maintaining a minimum average speed of from 24 to 25 knots an hour in moderate weather," and in order to be able to do this for 3000 miles and to carry enough coal whilst consuming 1000 tons a day, to say nothing of the passengers and mails, the enormous size was essential and indispensable. The mammoth type of ship was found during the war too cumbrous to be suitable as armed merchant cruisers, but their ability to carry about five thousand troops meant that nowadays whole armies could be transported across the world with ease. In that respect these ultra-big ships are a great national asset in time of war.

To the " Mauretania " belongs the honour of having made the fastest Atlantic voyage (other than the accomplishment by air), for she has steamed from Queenstown to New York in 4 days 10 hours 41 minutes. Built with turbines and quadruple screws, she has since

the war been turned into an oil-burner. The design of the stern and rudder in her and in the "Aquitania" you will see to be quite different from the " Olympic," and this was because of the subsidy; for if the Cunarders were to be used as cruisers they required certain tactical, naval modifications. The rudder is balanced, the steering gear similar to Admiralty practice and is below waterline. In the " Aquitania " especially, the stern is really a modified cruiser stern with a graceful ovrhanging counter added for appearance sake. The advantages of manœuvring power and larger immersed area of rudder are obvious. The " Olympic's " rudder, on the other hand, is of the ordinary kind with the steering gear above waterline, for she was under no Government obligation. She was launched in 1911, and is a bigger but slower mammoth. She is 852 ft. long, has three screws and a speed of 21 knots, her gross tonnage being 45,000. Of the three propellers, each wing shaft is driven by a reciprocating engine, and a turbine drives the middle one. She is, of course, oil-fuelled, and it was this mammoth which during the war not merely carried thousands of troops but actually sank a German submarine.

But the " Aquitania " is a bigger ship still, being 868 ft. long and of 47,000 gross tons. I saw her in her different stages of construction up to the moment when she was launched into the Clyde. Her double bottom, which you will see in the sectional model of her port side, extends practically her whole length and is between five and six feet high. There are eight decks and one partial deck called the orlop which extends only forward and aft of the machinery. In the double bottom water ballast, oil fuel and fresh water are carried. This turbine mammoth has four propellers and was designed for a speed of over 23 knots, but according to her Chief Engineer, in the spring of 1923 she made a spurt for half an hour at 34 knots, and for that matter the " Olympic " has touched 27.82 knots for a brief spell. But it is the

consistently excellent running of these ships, voyage after voyage, year by year, that wins our admiration. The "Aquitania" was barely ready when the war broke out in 1914. She was turned into an auxiliary cruiser and at first served with Admiral Phipps Hornby's cruiser squadron in guarding the Atlantic trade routes, but she was not suited for this work and after colliding with a Leyland liner she ceased to be a warship and did better work carrying troops.

This is the last British-built mammoth ship, so that we have not advanced during the last ten years. But after the end of the war we took over from Germany three of her mammoth Atlantic liners. The "Imperator" of 919 ft. length over all, and 52,117 gross tons, became the Cunard "Berengaria." She was launched in 1912 at Hamburg, and has 42,500 water tubes in her boilers, but the British mammoths such as the "Mauretania" and the "Olympic" have Scotch boilers. The second three-funnelled mammoth is the German "Bismarck," now the White Star "Majestic," of 56,551 tons, built in 1921 at Hamburg. This vessel is 915 ft. long, has four propellers, turbines, oil-fuel, double bottom, and an inner skin in two of the forward compartments up to the eighth of her eleven decks. An examination of the model will shew that this is up to the lower promenade deck. It is this ship which has all the boiler uptakes cunningly arranged at the side of the ship, and thus leaves the centre free of obstruction. The last mammoth to be seen in our models is the "Homeric" of the White Star Line. This 34,356-ton ship was built for the Germans at Danzig in 1922, and is 751 ft. long, and though she is not fast as we reckon speeds to-day, she has kept up 18.69 knots between England and America. Incidentally, she is the biggest twin-screw ship afloat.

And yet all these mammoth ships never look their size, so beautifully designed and proportioned are they, and surely it is one of

the highest forms of artistry to be able to design and build a 50,000-ton ship so that she still seems lovely. It is one of the finest examples of mind triumphing over matter. The real difficulty with these ships is to find suitable docks for them to be overhauled, and I have specially included here a model of a 60,000-ton lifting-power floating dock designed by Sir W. G. Armstrong, Whitworth & Co. for these mammoths using Southampton. This measures 960 ft. over all and 170 ft. wide.

Thus we have traced the steamer from the time of the tiny "Charlotte Dundas" to the mammoth "Majestic," and it is certain that the steam merchantman cannot develop much further. The future liner will be the big motor ship. Already this is foreshadowed by two pioneer vessels, of which one is the 600 ft. liner being built on the Clyde for the Union Steamship Company, New Zealand, and the other is the 20,000-ton motor ship being constructed for the Union-Castle Line carrying mails to South Africa. Very slowly the coal age is passing, and the wasteful oil-burning age will be overtaken by the internal combustion engine just as soon as high speeds can be obtained simply and reliably. But the sailing ship died fighting and so will the steam ship, and it is well that we have these models of her right up to her prime.

The cross-Channel services from this country have always been progressive in regard to the steamship. The earliest were, as we have seen, soon after the "Comet," and between Scotland and Ireland. In 1816 the "Hibernia" was steaming between Holyhead and Howth, in 1820 the "Rob Roy" was running between Dover and Calais, in 1822 there was a steam packet service between Liverpool and Dublin, there soon followed a weekly service between Rotterdam and Hull, and the advent of the railways gave these cross-channel services a further impetus. Practically the modern fast cross-

channel steamer is an Atlantic liner in miniature. It is required of them to carry mails and passengers between two terminal ports in the quickest time, and they are in effect really extensions of the respective railways. The result is that these short-passage ships are exceptionally efficient.

One of the most famous was that fine turbine steamer the "Queen," with her 21 knots. She was the first turbine steamer in the cross-Channel services, and before such engines were in liners. For a dozen years or so she ran regularly and then came the war, when she performed excellent work in transporting troops to France; but on the night of October 26-27, 1916, was attacked in the Dover Straits by enemy destroyers and sunk. The model here reproduced perpetuates her memory. The model of the "Queen Alexandra" shews a ship built in 1902 for service on the Clyde, and it was her immediate predecessor, the "King Edward" of 1901, which was the very first passenger steamer to have turbines. The "Queen Alexandra" was a similar ship with three turbines, and on her trials she actually attained a speed of 21.6 knots, her length being 270 ft. But most progressive has been the Liverpool to Isle of Man service, for the Isle of Man Steam Packet Company's craft are like perfect little liners and of the highest speed. With their red funnels and black boot-tops they do in fact closely resemble the huge Cunarders, and amusing incidents have happened of ignorant passengers coming aboard from the landing stage the wrong ship, in spite of a mere matter of twenty thousand tons or more differentiating the two types.

The model of the "Viking" shews a turbine Isle of Man steamer built in 1905 by Sir W. G. Armstrong, Whitworth & Co. You can see at a glance how she and the "Queen" approximated in design to the contemporary liners. This ship is 361 ft. over all, displaces 2610 tons, is triple-screw, and on her trials developed a speed of just

under 23 knots. The model of the "Anglia" shews a post-war built steamer running across from Holyhead to Ireland. She came out in 1920, is over 380 ft. long, and is driven by four turbines geared to two shafts. If you compare the stern and rudder with those of the "Aquitania" you will see how closely the cross-channel high-powered steamer continues to resemble the design of the biggest ships. The "Anglia" is a vessel of 3460 tons and owned by the L. M. & S. Railway Company. Geared turbines and cruiser sterns were introduced in 1912 to the cross-channel services in the L. & S. W. Railway Company's "Normannia" and "Hannonia," which run between Southampton and Havre, and they have now a more modern sister in the "Lorina" of 1504 tons, built in 1918 with geared turbines, cruiser stern and a speed of just under 20 knots. The model of this ship illustrates again how efficiently our smaller steamers have kept up with the improvements in bigger craft.

Of special service ships several models of shallow-draught steamers will be found here. These types are required for such rivers as the Niger, the Nile, the Tigris, and elsewhere. The "Inez Clarke" was built by Yarrows as far back as 1879 for the United States of Colombia, and had a speed of fifteen miles. This was a stern-wheeler, but a similar type with screw, twin rudders and more modern construction will be seen in the next model. In the "Valiant" model by Messrs J. S. White we have a three-deck stern-wheeler which they built for the Nigerian Government. The steamer "Egypt," with paddles at the side, was constructed by Messrs Thornycroft in 1907 for service up the Nile. All this long experience which our shipbuilders possessed in regard to these shallow-draught vessels was to be invaluable to us when the Mesopotamian campaign needed warships of this type during the Great War. A model here reproduced from the Imperial War Museum and built by Messrs Yarrow

shews one of the small gunboats used on the Tigris by our naval forces at that time. The original vessel measured 120 ft. long with 20 ft. beam, and such details as range-finder and guns will be readily seen in the model. This particular craft played an important part in the capture of Bagdad.

Two very different types of tugs are shewn in the next two models. The first is the well-known Portsmouth Admiralty tug "Dromedary," used for assisting H.M. ships in that harbour. It is to be noted that in this ship the paddle wheels can be driven independently of each other. She was built in 1894 by Messrs Barclay Curle for the Admiralty, and is 144 ft. long. But the twin-screw "Saratovski Ledokol" of 147 ft. over all is a combined ice-breaker and tug which was built by Sir W. G. Armstrong, Whitworth & Co. for Russia. The first requisite of ice-breaking craft is great structural strength. The specially-designed bow of this tug was for crushing the ice, and such vessels have to be built with powerful engines—in this ship they gave a speed of nearly twelve knots on trial—and the hull has to be able to sustain the shock of hitting the ice as well as of being squeezed. The design has been pretty well standardised as the result of experience as regards the Baltic.

The peculiar, rising forefoot in these craft is in order that the vessel may slide on to the ice, and the "Ermack," of which we give a striking model, has broken five-feet thick ice at nine knots and been through heavy pack ice straight away. This is a vessel of 8685 tons displacement and did her 15 knots on her speed trial. She has three propellers aft and one forward, the latter being there so as to draw away sternward the water from the ice on which the forefoot has climbed, and thus the ice is robbed of its support and becomes easier to crush. The propellers in these ships are specially designed for strength and efficiency. The "Ermack" was built for the Russian Government in 1898,

and the "Angara" the year following. This is a single-screw ship of only 1442 tons, but the same curious forefoot will be observed. The " Ledokol " belongs also to 1899 and has about the same displacement, but the " Ermack " (which was intended for Polar exploration work and to open channels in the Baltic ice for Russian warships) has remained in design and construction ideal for the job. With an inner bottom rising well up each side, she was practically a ship within a ship, but in her first voyage it is not surprising to learn that the forward screw was damaged and the shaft bent by Polar ice. These were removed by her builders and a new bow fifteen feet longer was added.

The model of the " Baikal " shews a combined railway-ferry-ice-breaker for connecting the two ends across Lake Baikal of the Trans-Siberian railway, for during the winter connection would otherwise be lost. The " Baikal " was made to carry twenty-five cars on deck at 13 knots. She was taken out to Russia in sections and put together again in 1897-8; she has one propeller forward and one aft, and can force her way through three feet thick ice. The "Saralovskaia Pereprava " is another amazing steamship development and is known as a lift train ferry. This strange craft draws only 7½ ft. laden and was built for Russia by Sir W. G. Armstrong, Whitworth & Co. for service on the Volga. Inasmuch as the difference in the height of waterlevel is so great, there was nothing for it but to add hydraulic lifts to the bow of the ship for raising the train carriages. This "Saralovskaia" had to be made in four sections which were floated separately through lock gates into the Volga and then she was joined together.

The " Scotia " model shews a railway ferry steamer built for the Canadian Government in 1901, with a propeller and rudder at each end for ease in handling, her speed being about 10 knots. But a bigger ice-breaking train ferry is the " Prince Edward Island," 4640 tons, built in 1915 for the Canadian Government. She is a sea-going

ship with a 14-knot speed, and three propellers—two aft and one forward. This " closed " type of train ferry is exceptionally strong, especially on the car deck where the rails are laid, and it shews this particular kind of steamer in its modern development. All the models of these ice-breaking ships and train ferries have been lent me by Sir W. G. Armstrong, Whitworth & Co., Ltd., who have done more than anyone to make this highly specialised type of steamer so valuable to navigation.

The paddle ferry steamers " Squires " and " Gordon " were built by Messrs J. S. White & Co. for the London County Council, and are well known on the Thames; they are really a special kind of shallow-draught vessel for a particular purpose. The three trawler types of which we give models shew how steam has abolished the old-fashioned fishing vessel. In fact, ever since the 'eighties sail has gradually been ousted, especially in the North Sea, but exactly the opposite has been the case with the Brixham fleet, which still sticks to sail and contains only a couple of steamers. The Great War gave a great fillip and encouragement to the design and building of the steam trawler, and they were used in hundreds for minesweeping and anti-submarine patrol. The model of the " Daniel Henley " shews a patrol vessel with a gun mounted abaft the funnel, and her trawl "gallows" both forward and aft. This model and the "Arctic Whale" are by courtesy of the builders Messrs Smith's Dock Company. Wholesome, single-screwed vessels, able to stand any kind of weather, the largest class run to about 170 ft. in length and the smallest ones to about 100 ft. Of the work which these sturdy ships performed during the war I have written at length in my " Auxiliary Patrol " : it is, therefore, only necessary to call attention to the charming little model of the " William Leech " which is in the Imperial War Museum and shews one of the bigger class, 138 ft. long. This model is on the scale

of ¼-inch to the foot. The details of the ship with her two guns, gallows, wireless, and so on will be remarked with interest by those who were accustomed to use the sea in these ships' company. The "Arctic Whale" was one of a new type of steam trawler evolved during the war, known as the "whaler" class. They were a kind of small gunboat and the sharp forefoot was for ramming submarines; but this "whaler" type was rather disappointing as a seaworthy design and eventually no more were built. On the whole it would be difficult to beat the genuine steam trawler for all-round rough sea work where high speed is not required.

Another special type of steamship is the oil-tanker, and it is only from the 'eighties that the practice has become general of carrying across the ocean oil in bulk and not in casks. Now-a-days when the use of oil threatens to make coal obsolete there is considerable work to be done by these oil-tank steamers. They require special design and construction, the fitting of special pipes and pumps and a large number of bulkheads. The model of the tank steamer "Strombos" with single screw and engines aft shews a vessel of 8450 tons deadweight and 6030 gross tons, with a speed of over 10 knots, built in 1900. The sectional model of the tanker "Tiflis" will enable the reader to see how a vessel of the same year was bulkheaded. Thse two models and that of the tanker "Silverlip" are of vessels by Sir W. G. Armstrong, Whitworth & Co. This last-mentioned ship was built in 1903. There are fifteen transverse and one centre line bulkhead, trunks being carried up to allow for the oil's expansion. Large hatchways, as in the "Strombos" are fitted to allow of loading with ordinary cargo when outward bound to the oilfields, and the sixteen derricks worked by steam winches are conspicuous. Ever since the discovery of oil in Texas about twenty-four years ago, there has been a great demand for

these tank steamers, and some of them have become of considerable size.

Finally, we have a series of models showing the influences which have been at work in the steam yacht, whose pioneer was Mr Assheton Smith, a well-known sportsman of the first part of the last century. He it was who built for himself a paddle-wheel yacht in 1825, but two years later the Royal Yacht Squadron passed a resolution to the effect that since a material object of the club was to promote seamanship and improvement of sailing ships, to which the application of steam was "inimical," they resolved that any member "applying steam engines to his yacht shall . . . cease to be a member."

Thus, like the Admiralty and others, the most exclusive yacht club did all it could to discourage steam. None the less, steam came in, Smith eventually resigned from the R.Y.S., and he owned eight more steam yachts up to the year 1851. It was five years later that the same club cancelled its arbitrary rule, and down to 1864 there were only 30 yachts which had steam, but from then the numbers increased. The model of the S.Y. "Hebe" was built in 1869, and for over fifty years she was owned by the Coats family. This model was made for Sir Thomas Glen-Coats, and the heavy quarters with beautiful gilt work were characteristic of the time. The "Hebe" was of 310 tons, her length being 145.6 ft., 21.7 ft. beam, draught 9.7 ft. The reader will find it worth while to compare her with the naval and mercantile steamships at that date.

The model of the Russian Imperial S.Y. "Livadia," launched in 1880, was a freak design of the Russian Admiralty, built on the Clyde, with the lower part of the hull turbot-shaped. Above this was the ordinary superstructure, and then on the upper deck were the Imperial suite, with an awning deck above that. This remarkable monstrosity of 11,802 tons (Thames measurement) was a failure even as a seaworthy

ship, and the remarkable thing is that she actually attained a speed of over fifteen knots on her trials.

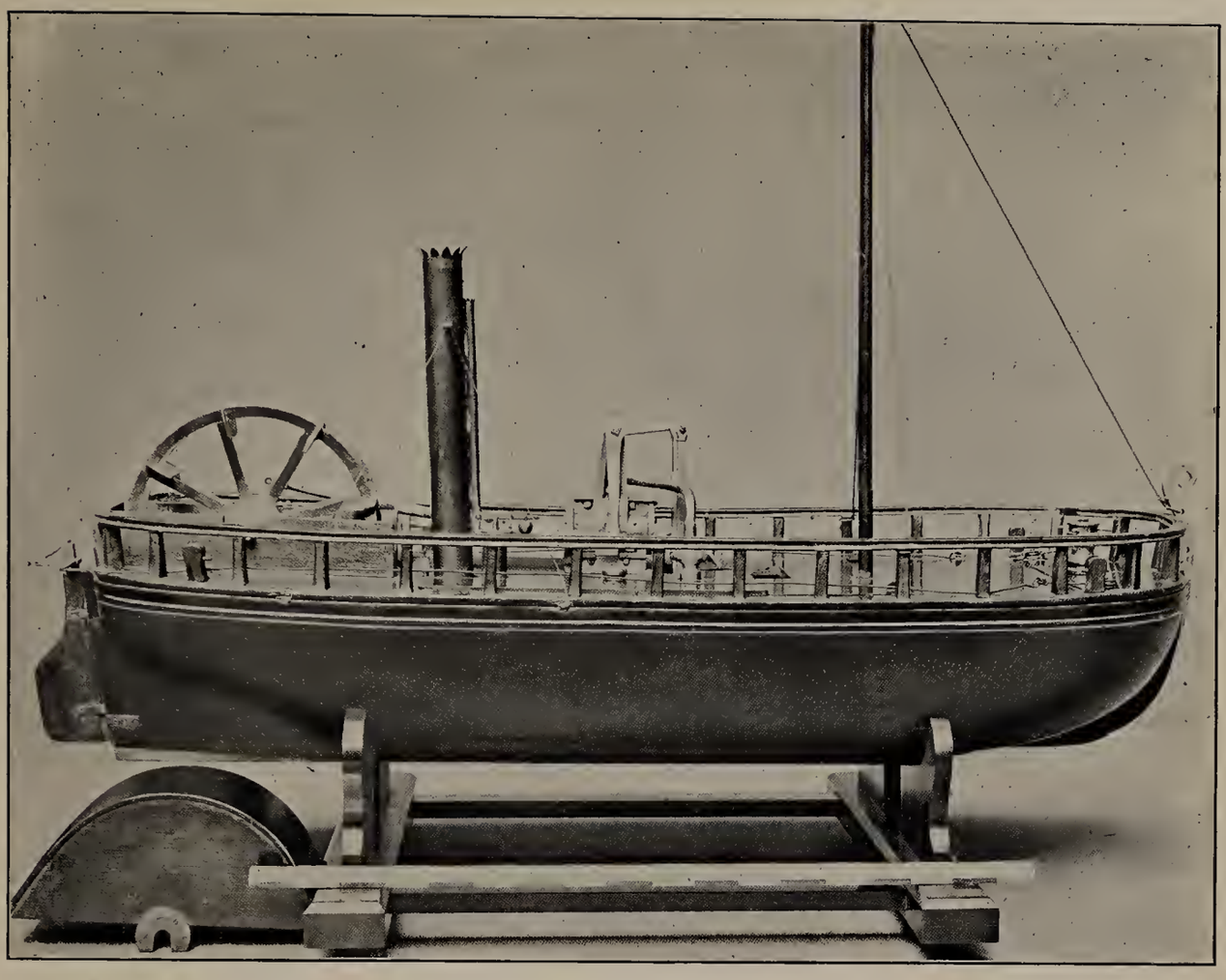
But no one did so much for the perfecting of steam yacht design as the late Mr G. L. Watson, one of the greatest naval architects of the nineteenth century, and it is to his firm that I am indebted for an interesting series of examples. The S.Y. "Maria" was built in 1896 for Mr N. B. Stewart of the New York Yacht Club. Her typical counter stern and gentle lines are a delight to behold. Her dimensions are 815 tons, 228 ft. long, 27.65 ft. beam, and 17.8 ft. deep. Eight years later came the "Katoomba I." of 469 tons, built for Mr Kenneth M. Clark, and this model well shews the type to which the moderate-sized steam yacht had settled down. The S.Y. "Margarita," built for an American owner, was bigger, more of a ship, with twin screws, but the same unmistakeable Watsonian tradition was carried on in her.

These craft with their schooner bow and bowsprit shew the convention which existed until the present century and was very rarely changed except in such unusual yachts as the "Sagitta" and "Triad." But it is fitting to close with the model of the S.Y. "Thalassa" which is now being built for Mr Eugene Higgins from designs by Messrs G. L. Watson & Co. Here we have a thoroughly modern, up-to-date design, with a so-called canoe-stern, but a bow far more akin to the merchant ship than the ordinary yacht. This 700-ton ship is a sound, seamanlike looking vessel and capable of enduring much more than the smooth summer seas of the Solent. Twin-screwed, over a hundred and eighty-two feet long, we have thus reached the last word in steam propulsion as applied to pleasure craft.

And here, now that we have followed these picturesque models since the "Charlotte Dundas" of 1801, we may end our story.

Perhaps when the age of steam has passed and the oil age has in turn become supreme, we shall reverence these lovely bits of deft skill and preserve them for the generations who will have missed the privilege of having lived in this wonderful period of the greatest shipping activity since the beginning of the world.

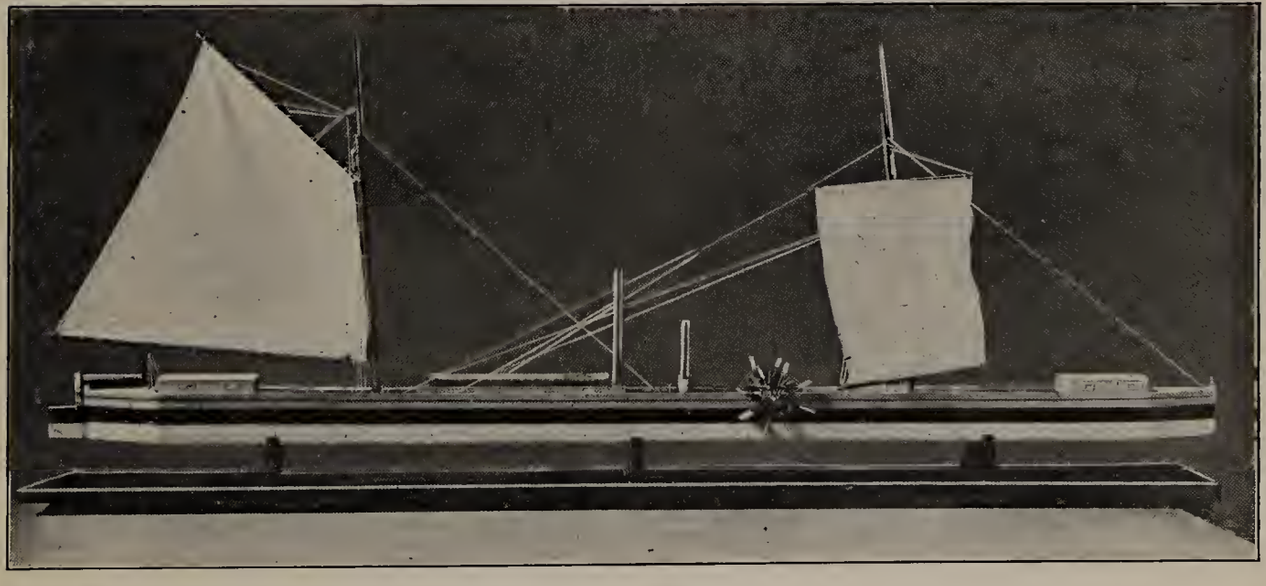
PLATE 2



(Science Museum, South Kensington)

CHARLOTTE DUNDAS (1801)

PLATE 3



(Smithsonian Institution, United States Naval Academy)

CLERMONT (1807)



(Science Museum, South Kensington)

COMET (1812)

PLATE 5

" WILLIAM FAWCETT " (1829)
(*Messrs Peninsular & Oriental Steam Navigation Co.*)

PLATE 5

" WILLIAM RAWLEY " (1920)

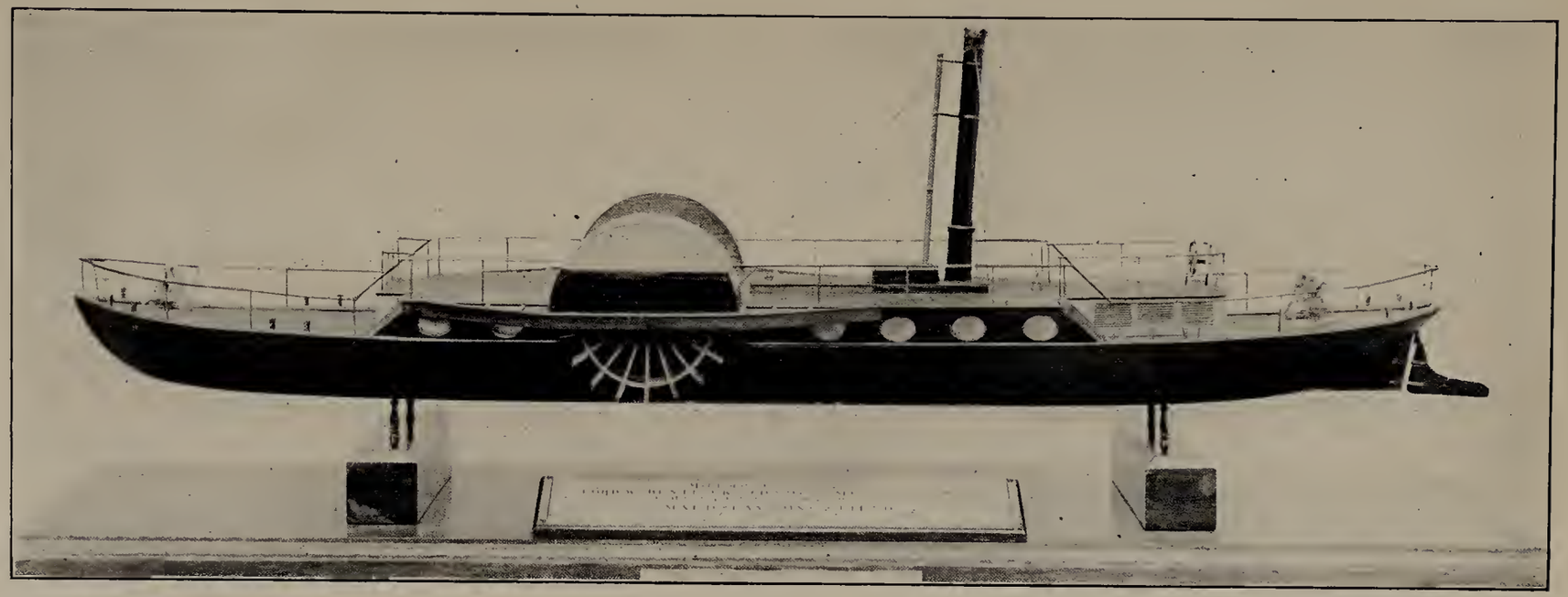
(Messrs Pembroke & Orwell Steam Navigation Co.)



PLATE 6

"BRITANNIA" (1840)
(*Messrs Cunard Steam Ship Company*)





(Science Museum, South Kensington)

FIRST IRON STEAMER BUILT ON THAMES (1832)



(Science Museum, South Kensington)

PADDLE FRIGATE (1840)



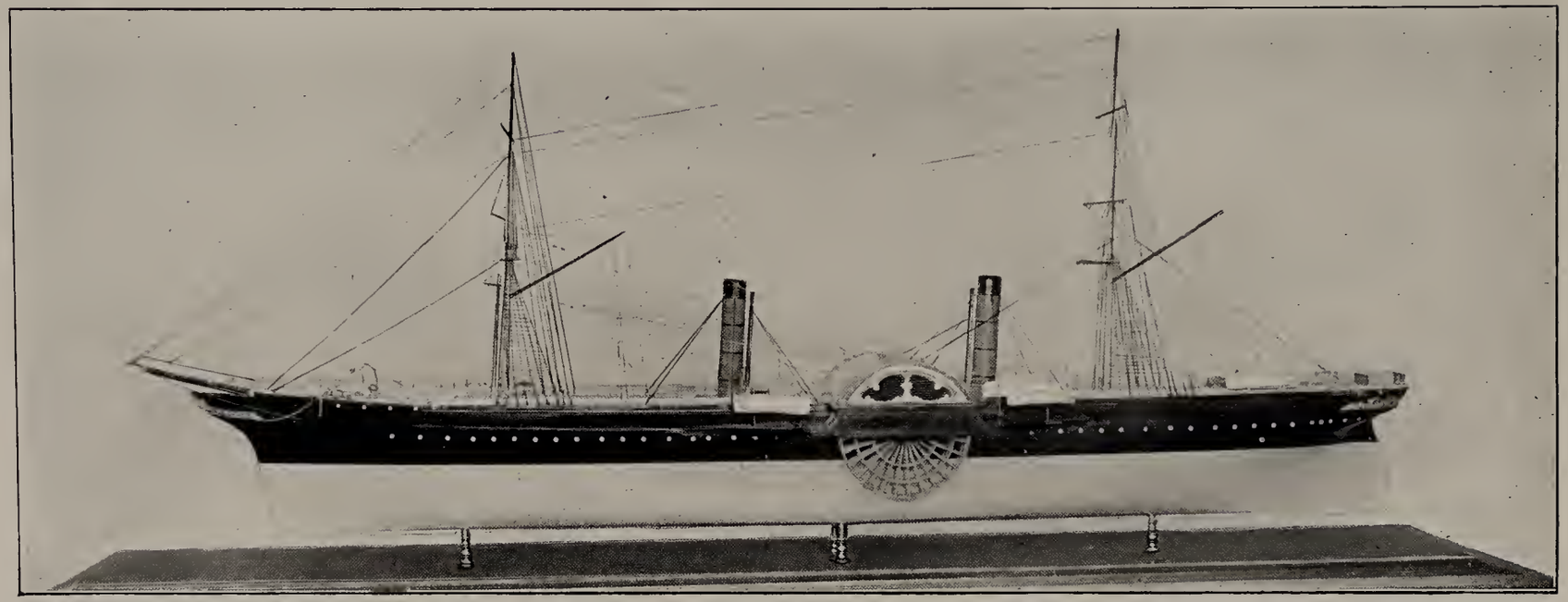
(Science Museum, South Kensington)

GREAT BRITAIN (1843)



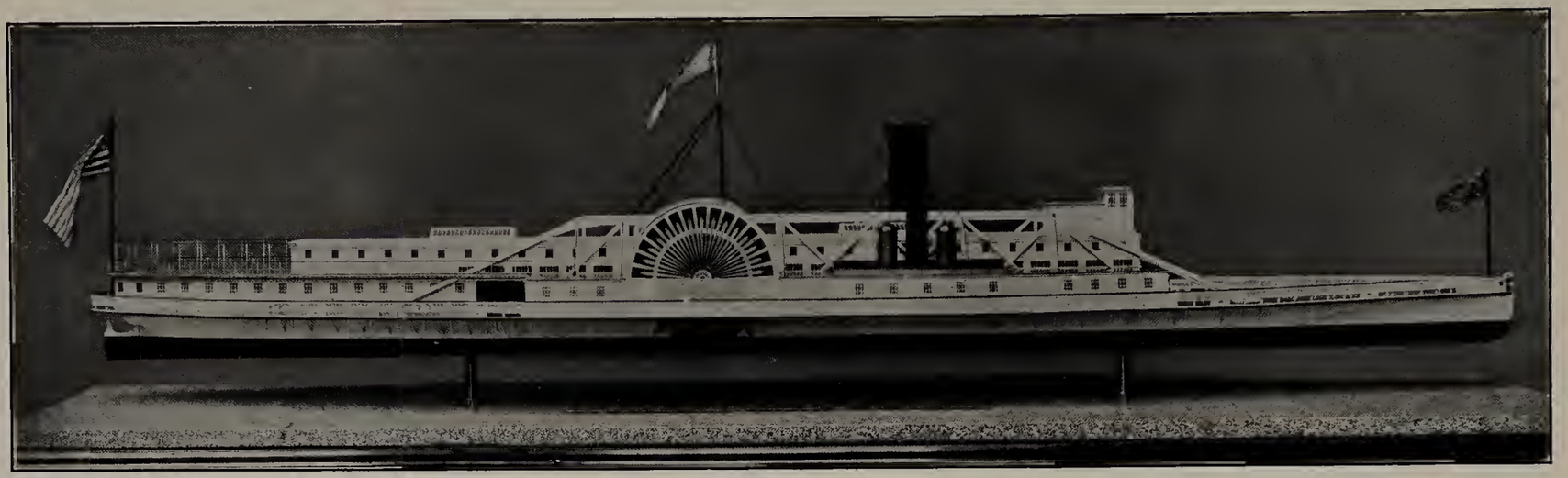
(Science Museum, South Kensington)

CUNARD PADDLE STEAMER HIBERNIA (1843)



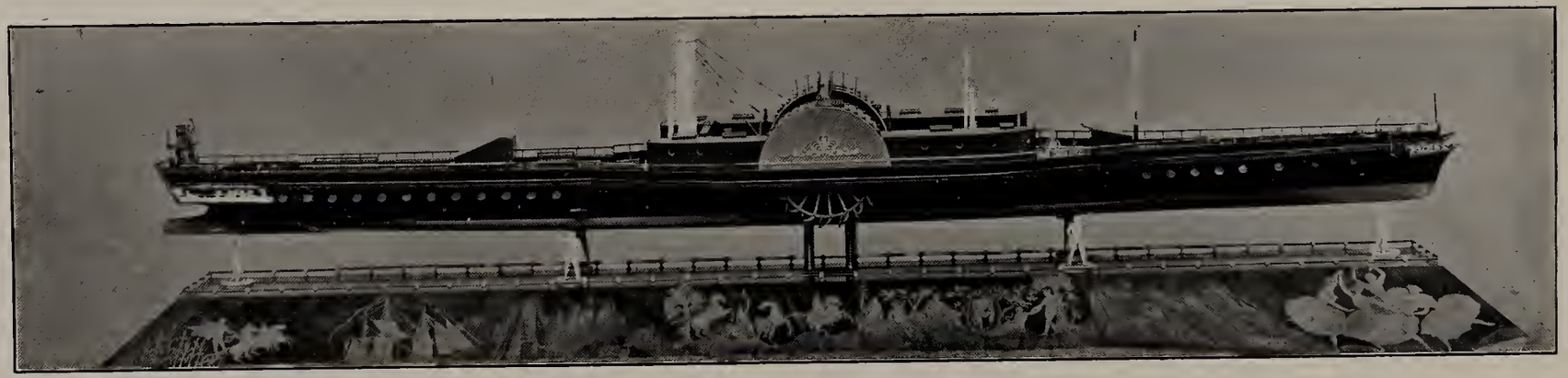
(Messrs Cunard Steam Ship Co. Ltd.)

SCOTIA (1862)



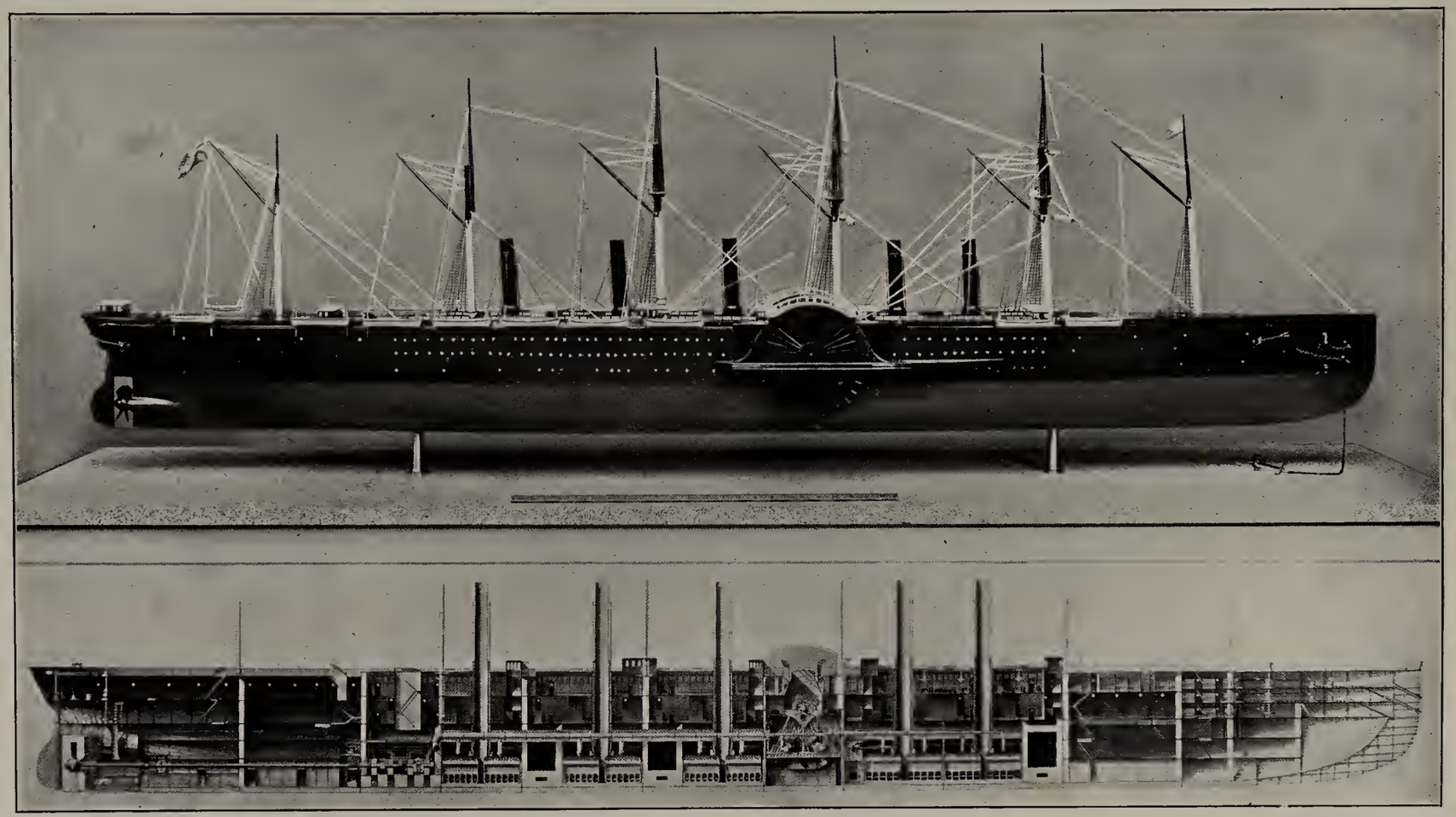
(Science Museum, South Kensington)

EMPIRE (1843)



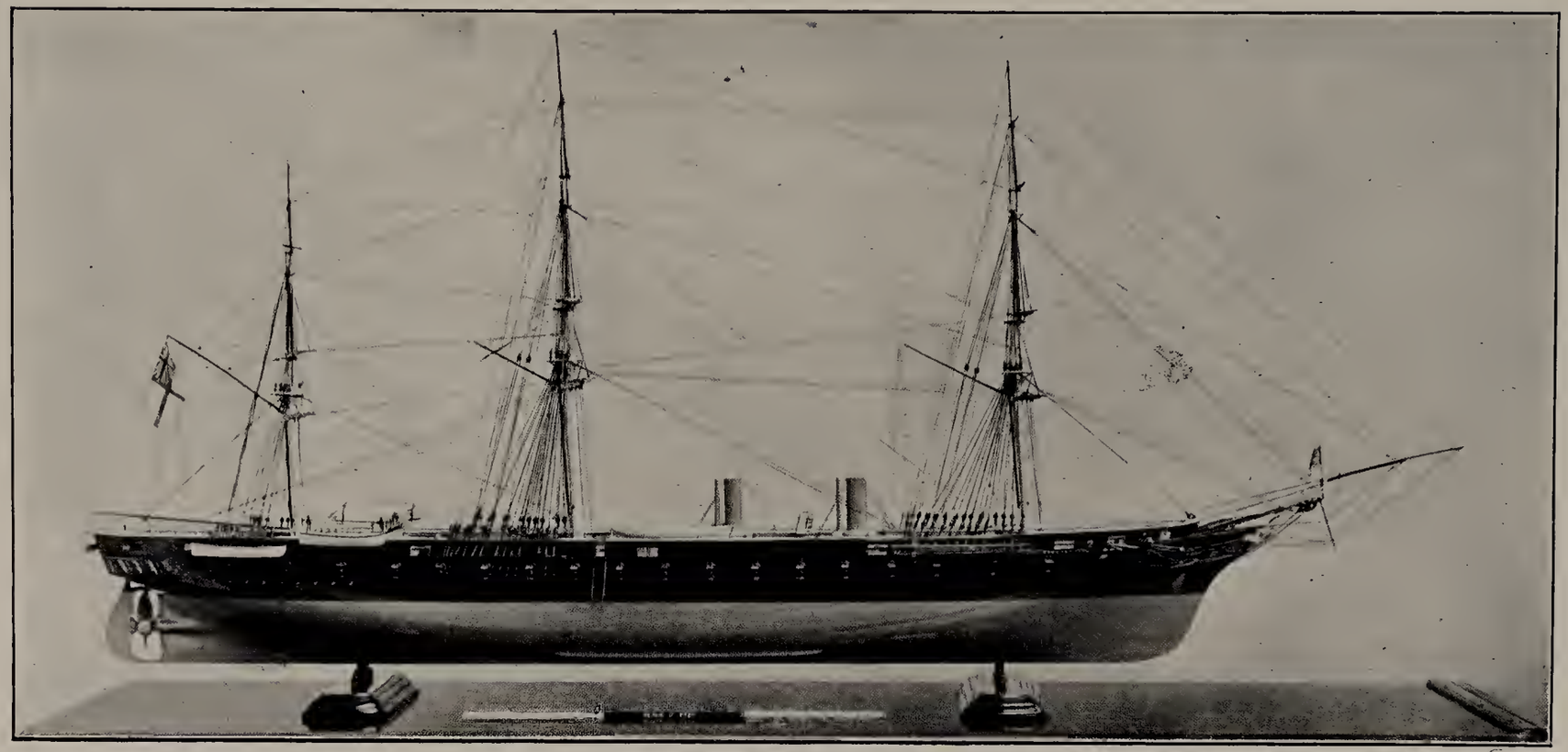
(Science Museum, South Kensington)

FIRST DANUBE STEAMER (1846)



(Scicnce Museum, South Kensington)

GREAT EASTERN (1853-8)



(Science Museum, South Kensington)

H.M.S. HIGHFLYER (1851)



(United States Naval Academy)

(White Studio)

U.S.S. HARTFORD (1858)



(United States Naval Academy)

(White Studio)

U.S.S. COLORADO (1856)

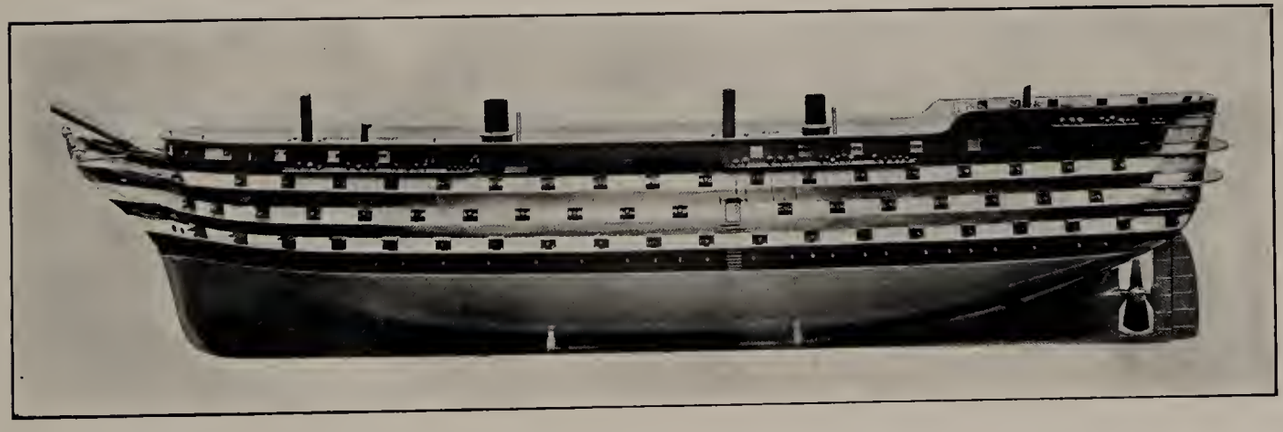
PLATE 18



(United States Naval Academy)

U.S.S. ANTIETAM (1862-1876)

PLATE 19



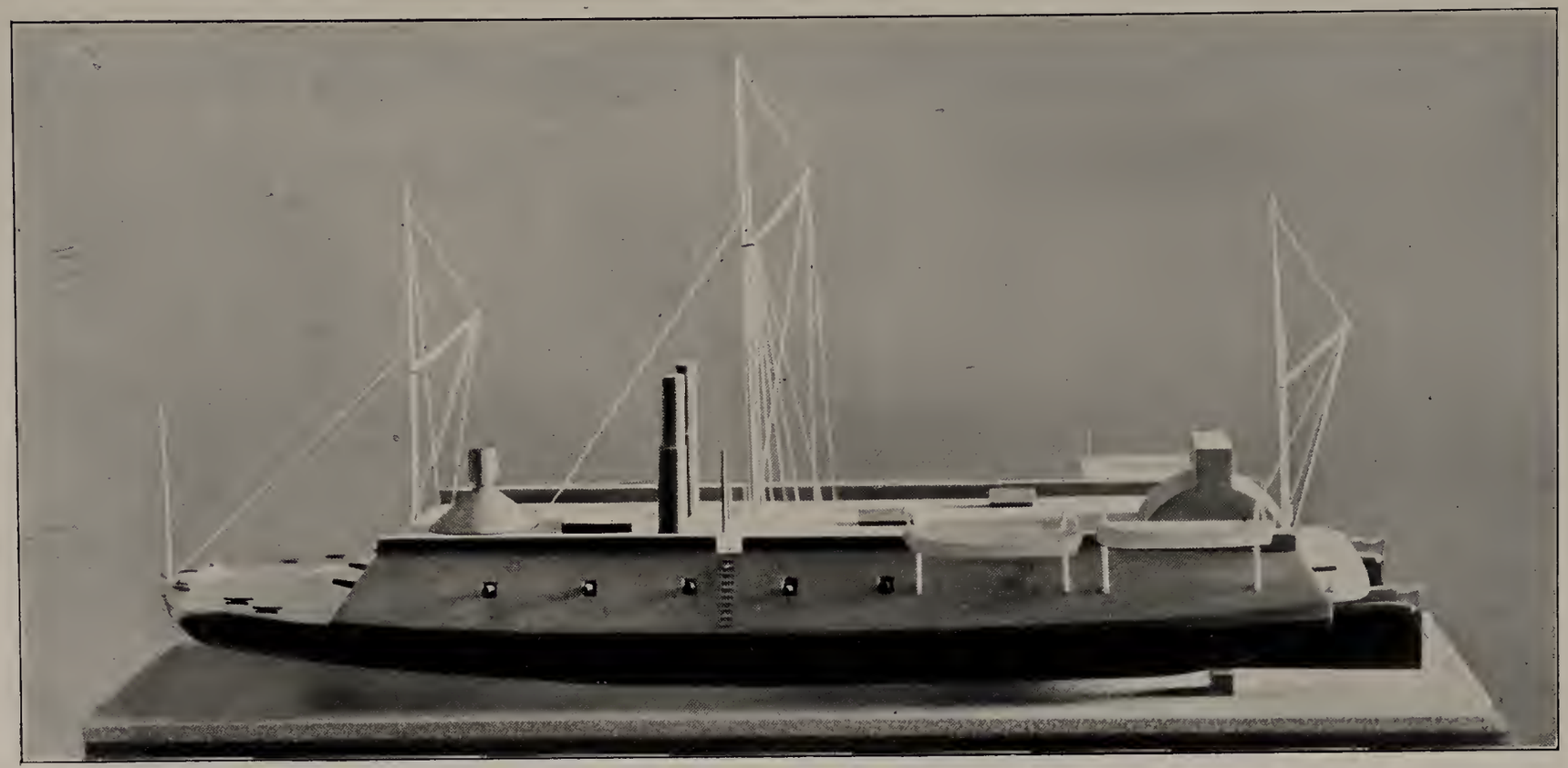
(Royal Naval Museum, Greenwich)

H.M.S. HOWE (1860)



(Science Museum, South Kensington)

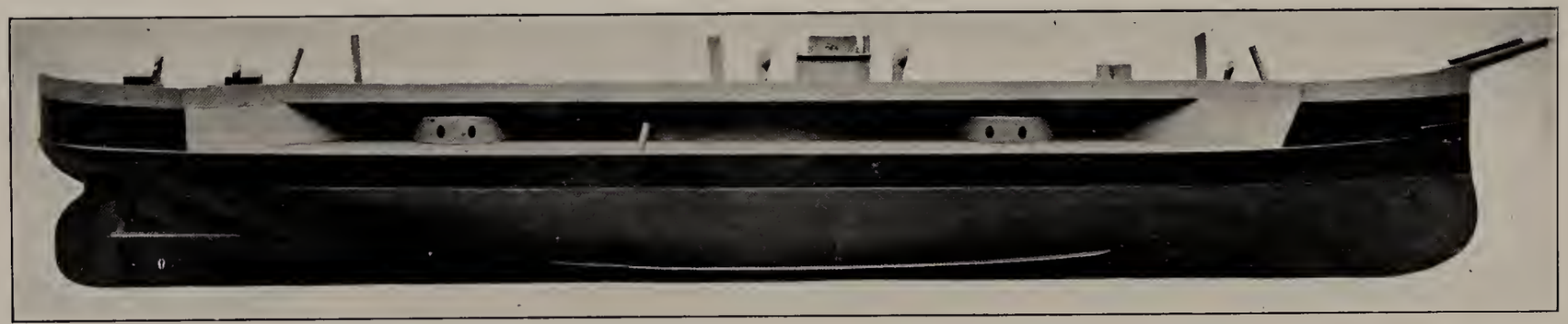
H.M.S. WARRIOR (1861)



(United States Naval Academy) *(White Studio)*

U.S.S. BENTON (1861)

PLATE 22



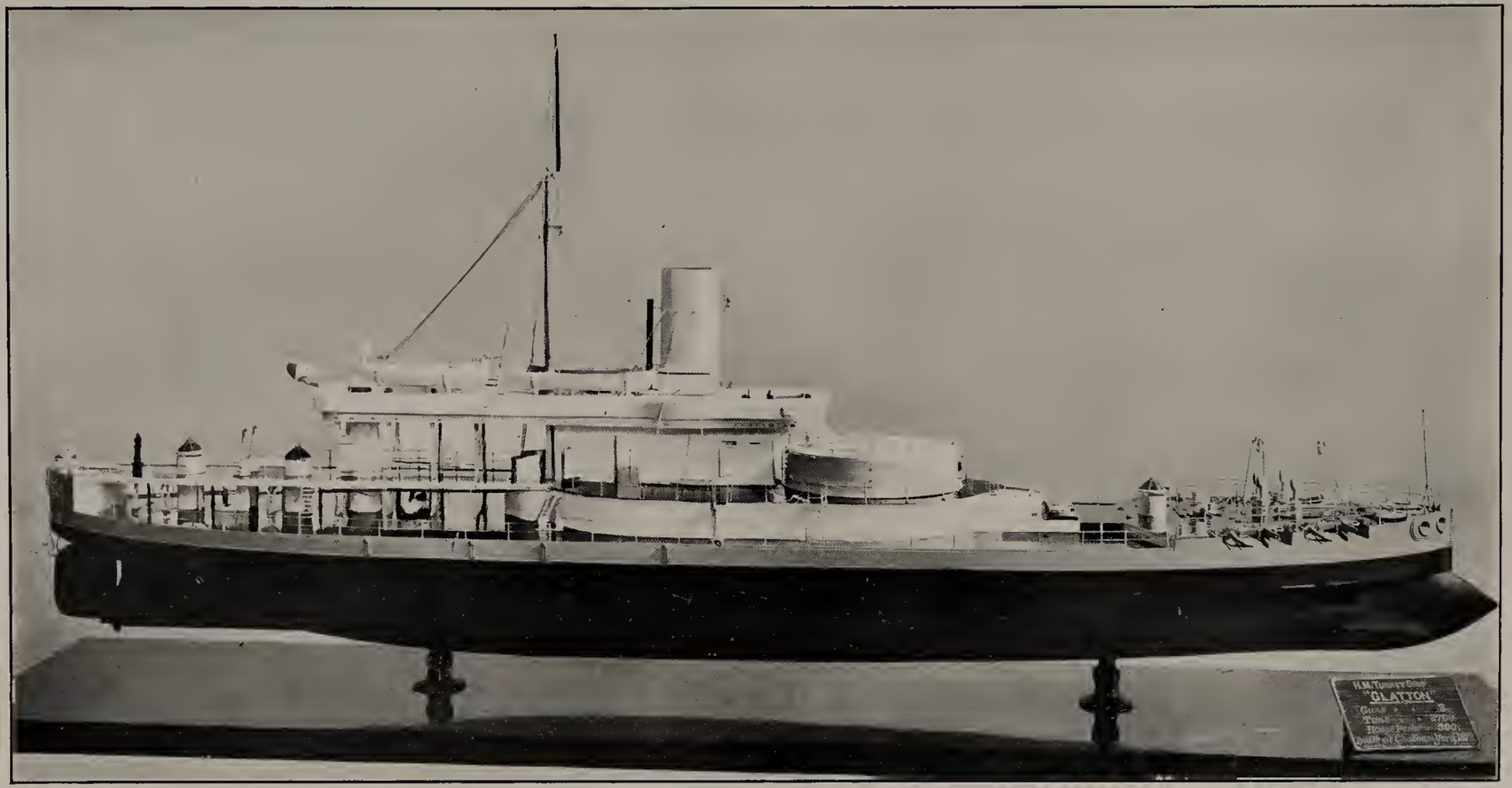
(Royal Naval College, Greenwich)

H.M.S. CAPTAIN (1870)



(Royal Naval College, Greenwich)

H.M.S. DEVASTATION (1871)



(Royal Naval College, Greenwich)

H.M.S. GLATTON (1872)



(Royal Naval College, Greenwich)

H.M.S. INFLEXIBLE (1876)



(Science Museum, South Kensington)

TURKISH FRIGATE OSMANEA (1866)



(Royal Naval College, Greenwich)

JAPANESE SLOOP SEIKI (1875)



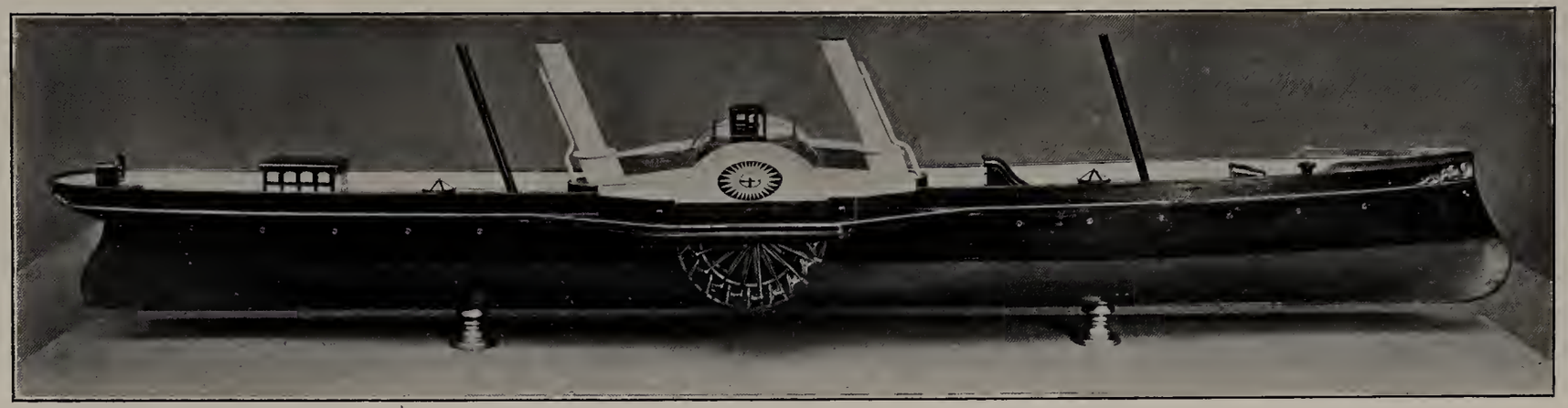
(Science Museum, South Kensington)

MEXICAN GUNBOAT MEXICO (1875)



(Science Museum, South Kensington)

PORTUGUESE IRONCLAD VASCO DA GAMA (1876)



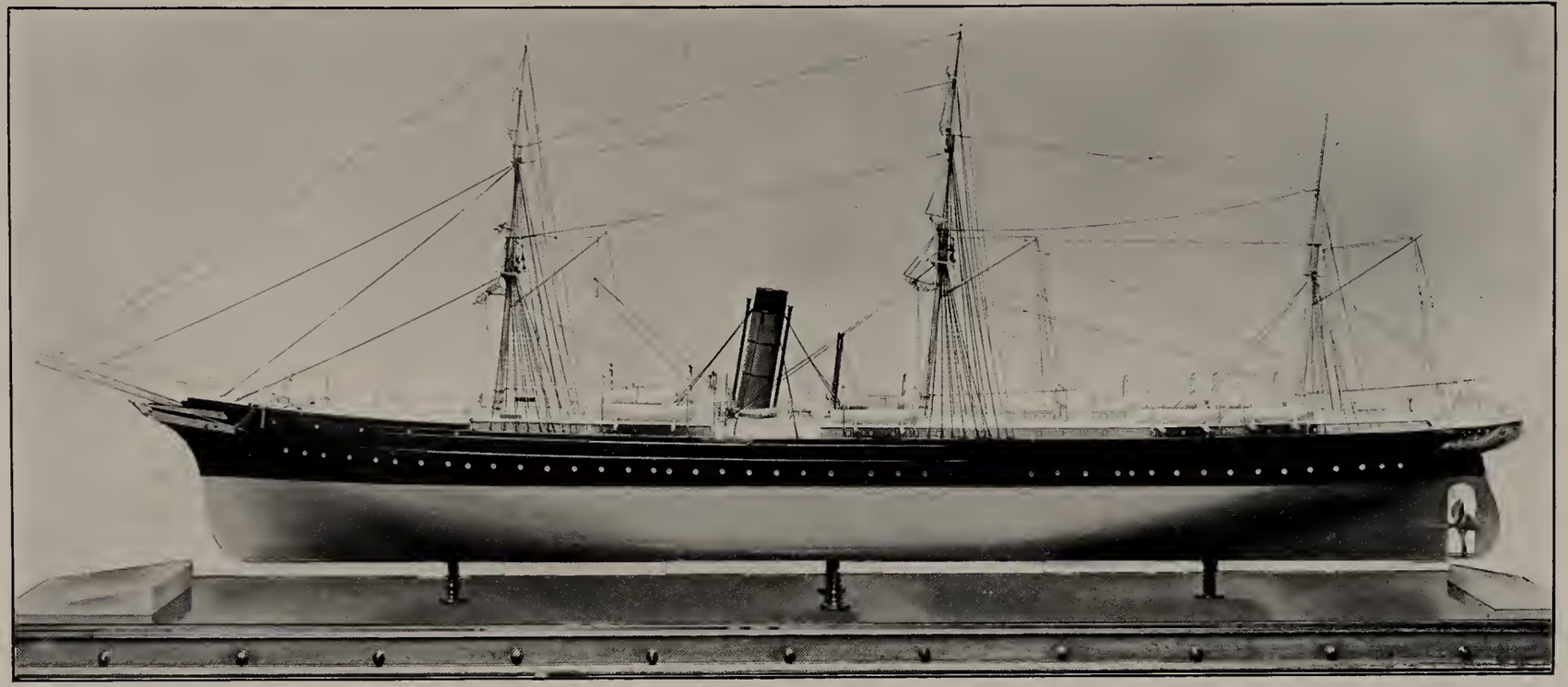
(Science Museum, South Kensington)

H.M.S. HELICON (1865)



(Science Museum, South Kensington)

CITY OF PARIS (1866)



(Messrs Cunard Steam Ship Co. Ltd.)

RUSSIA (1867)



(Messrs Cunard Steam Ship Co. Ltd.)

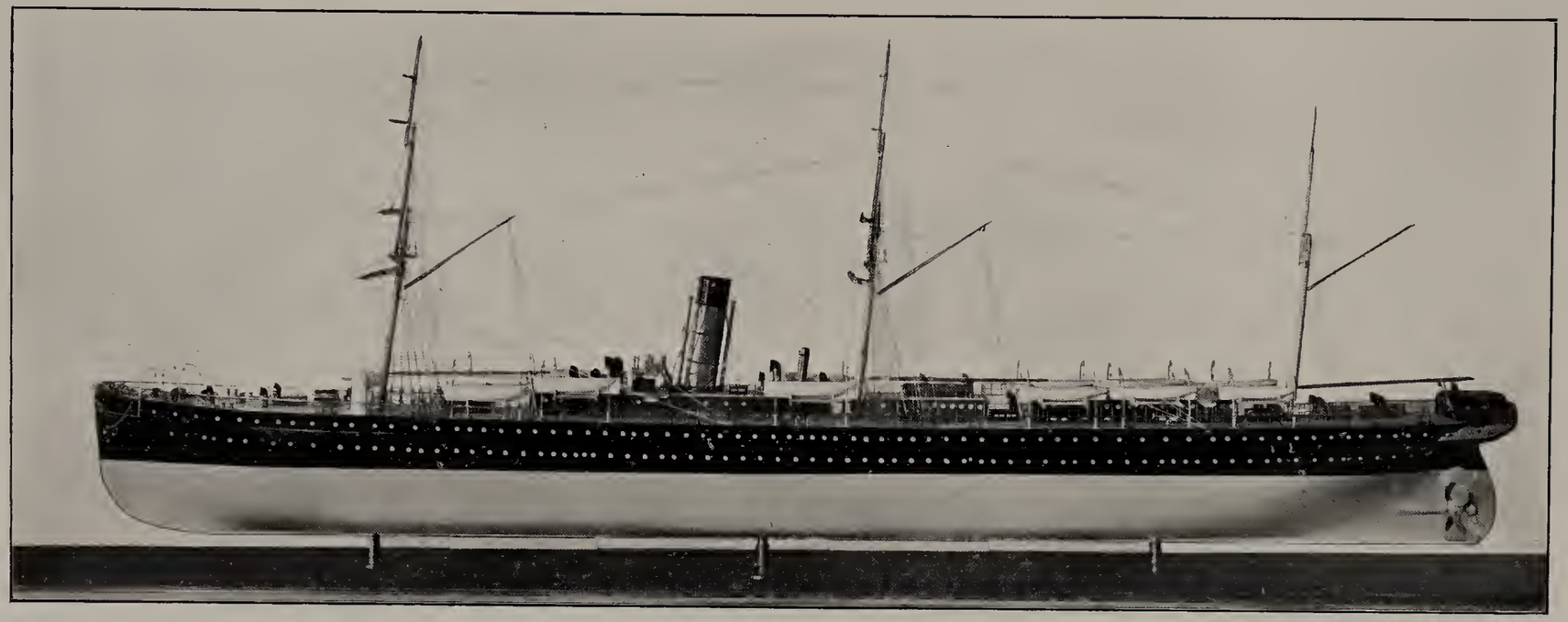
ABYSSINIA (1870)



(Science Museum, South Kensington)

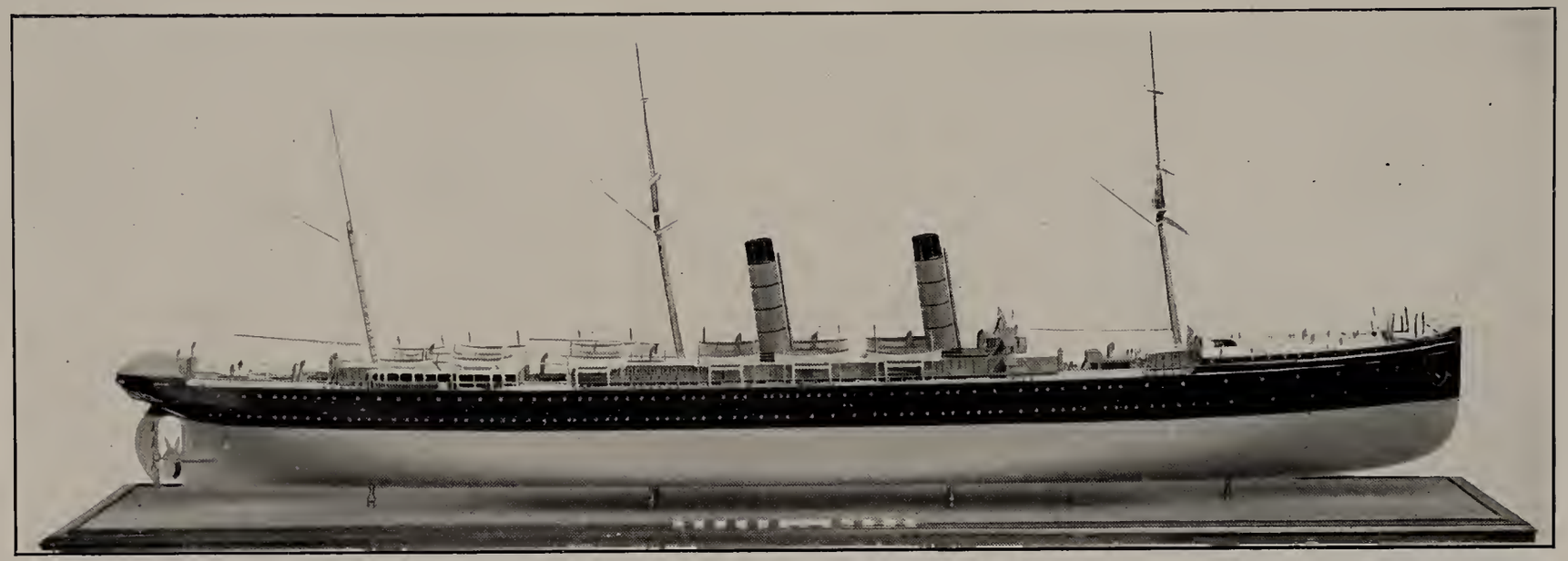
(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

ARIZONA (1879)



(Messrs Cunard Steam Ship Co. Ltd.)

GALLIA (1879)



(Science Museum, South Kensington)

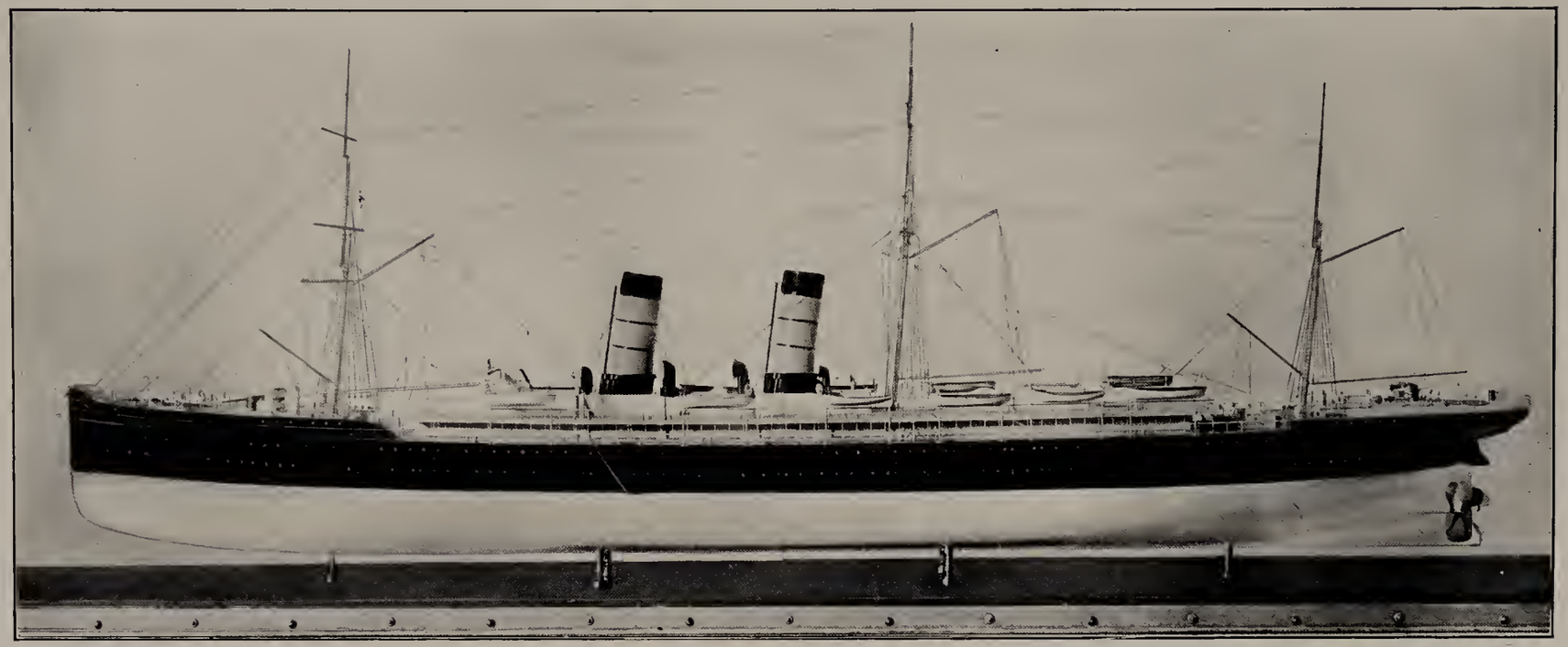
(Messrs Cunard Steam Ship Co. Ltd.)

SERVIA (1881)



(Science Museum, South Kensington)

CITY OF ROME (1882)



(Messrs Cunard Steam Ship Co. Ltd.)

UMBRIA (1884)



(Science Museum, South Kensington)

TAROBA (1888)



(Science Museum, South Kensington)

(White Star Line and White Star-Dominion Line)

CITY OF PARIS (1889)



(Science Museum, South Kensington)

(Messrs Union-Castle Mail Steamship Co. Ltd.)

SCOT (1891)



(Messrs Cunard Steam Ship Co. Ltd.)

CAMPANIA (1892)



(Science Museum, South Kensington)

(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

OMRAH (1898)

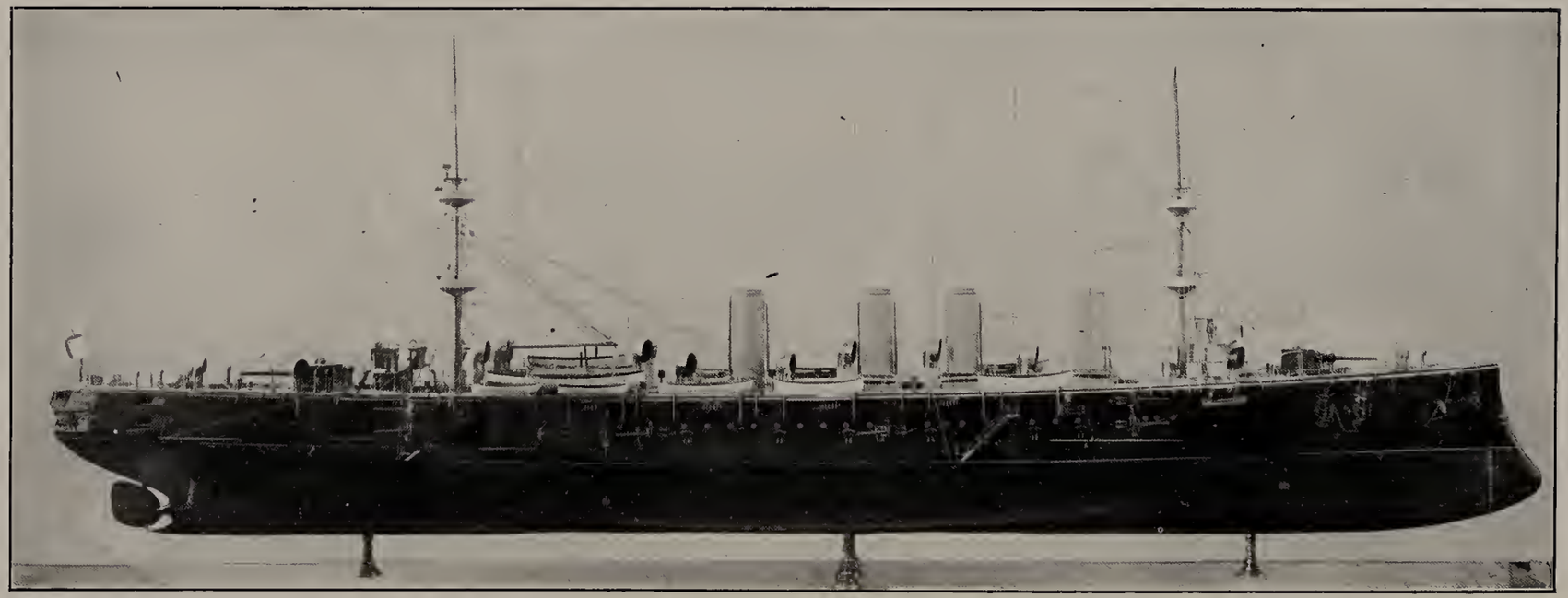


(United States Naval Academy)

U.S.S. CHICAGO (1885)

(White Studio)

PLATE 45



(Royal Naval College, Greenwich)

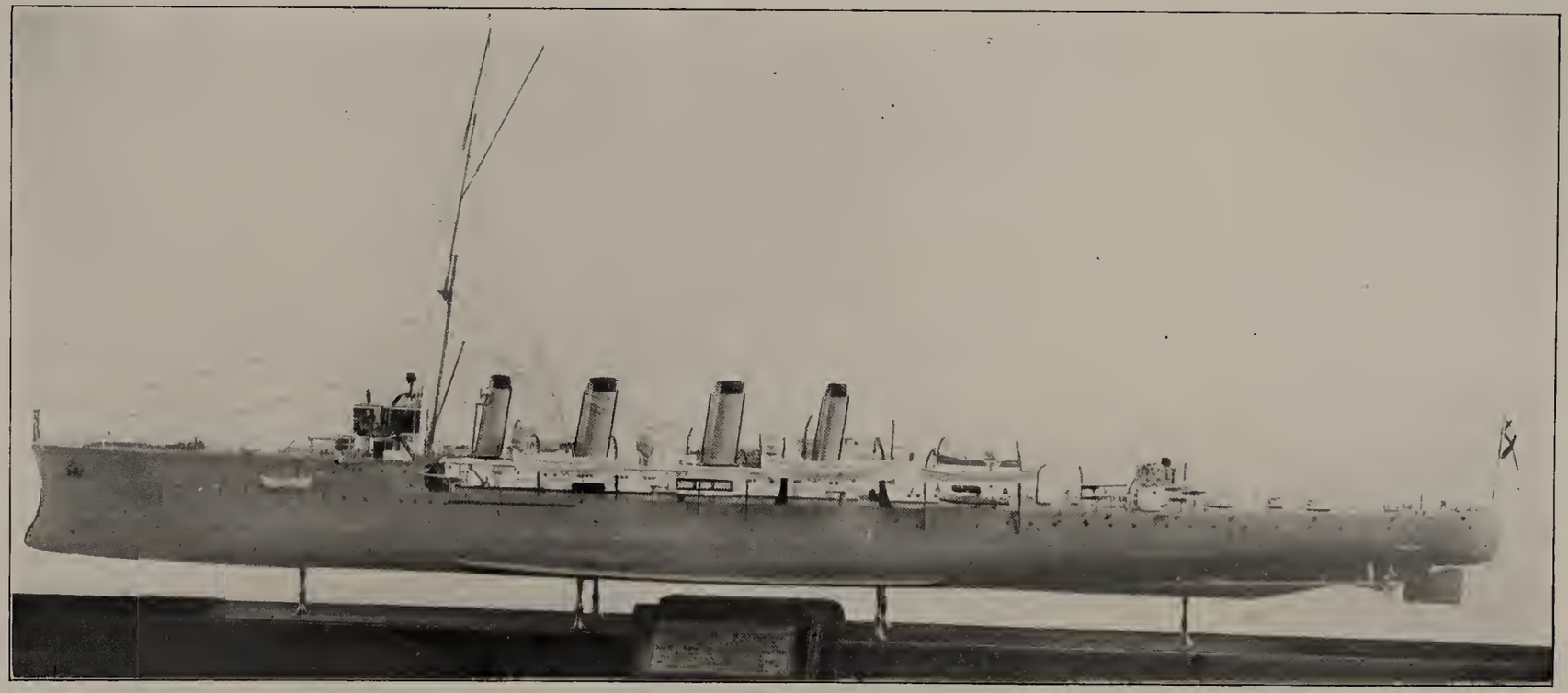
H.M.S. POWERFUL (1895)



(Royal Naval College, Greenwich)

H.M.S. LEVIATHAN (1901)

PLATE 47



(Royal Naval College, Greenwich)

H.M.S. ADVENTURE (1905)



(Science Museum, South Kensington)

(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

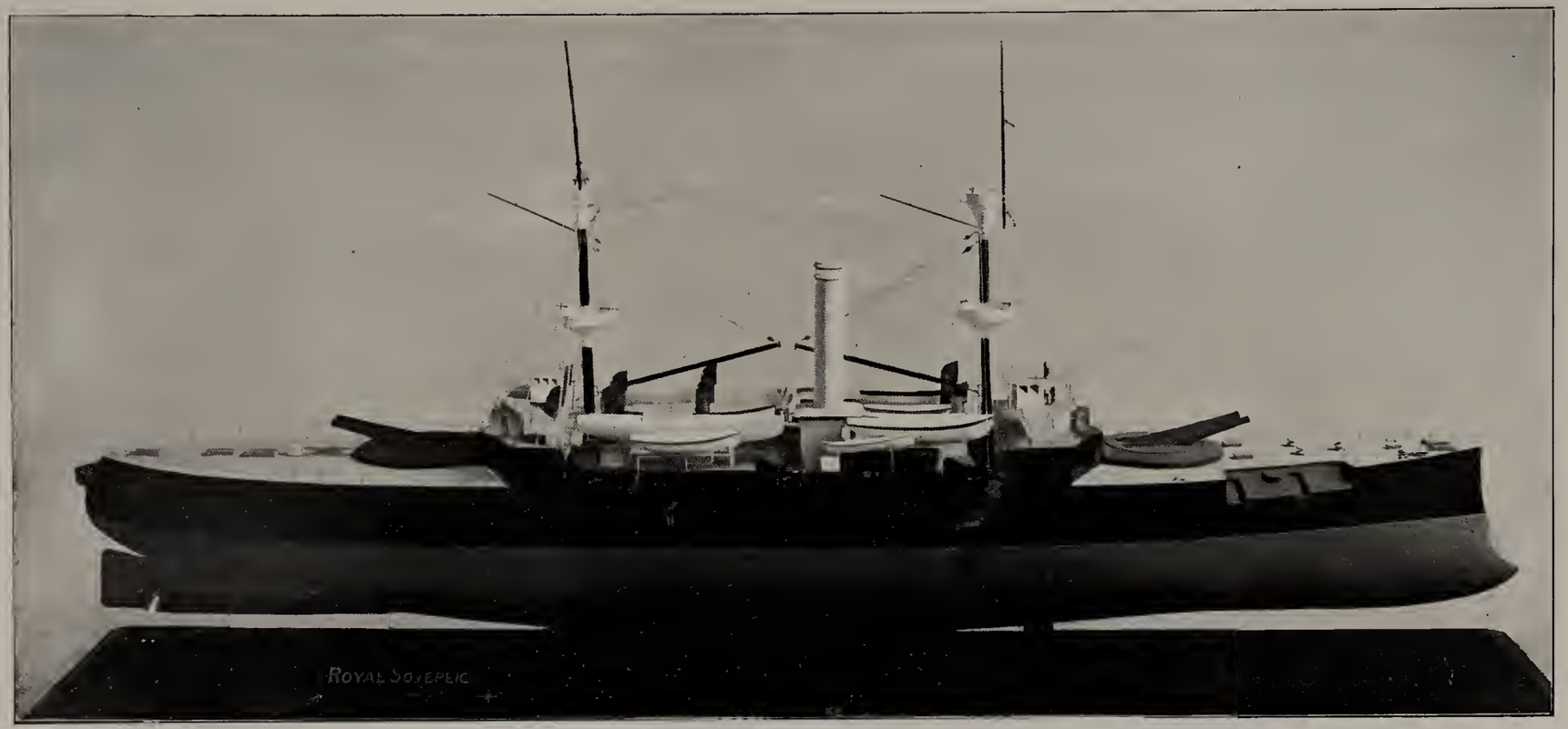
H.M.S. GLASGOW (1910)



(Science Museum, South Kensington)

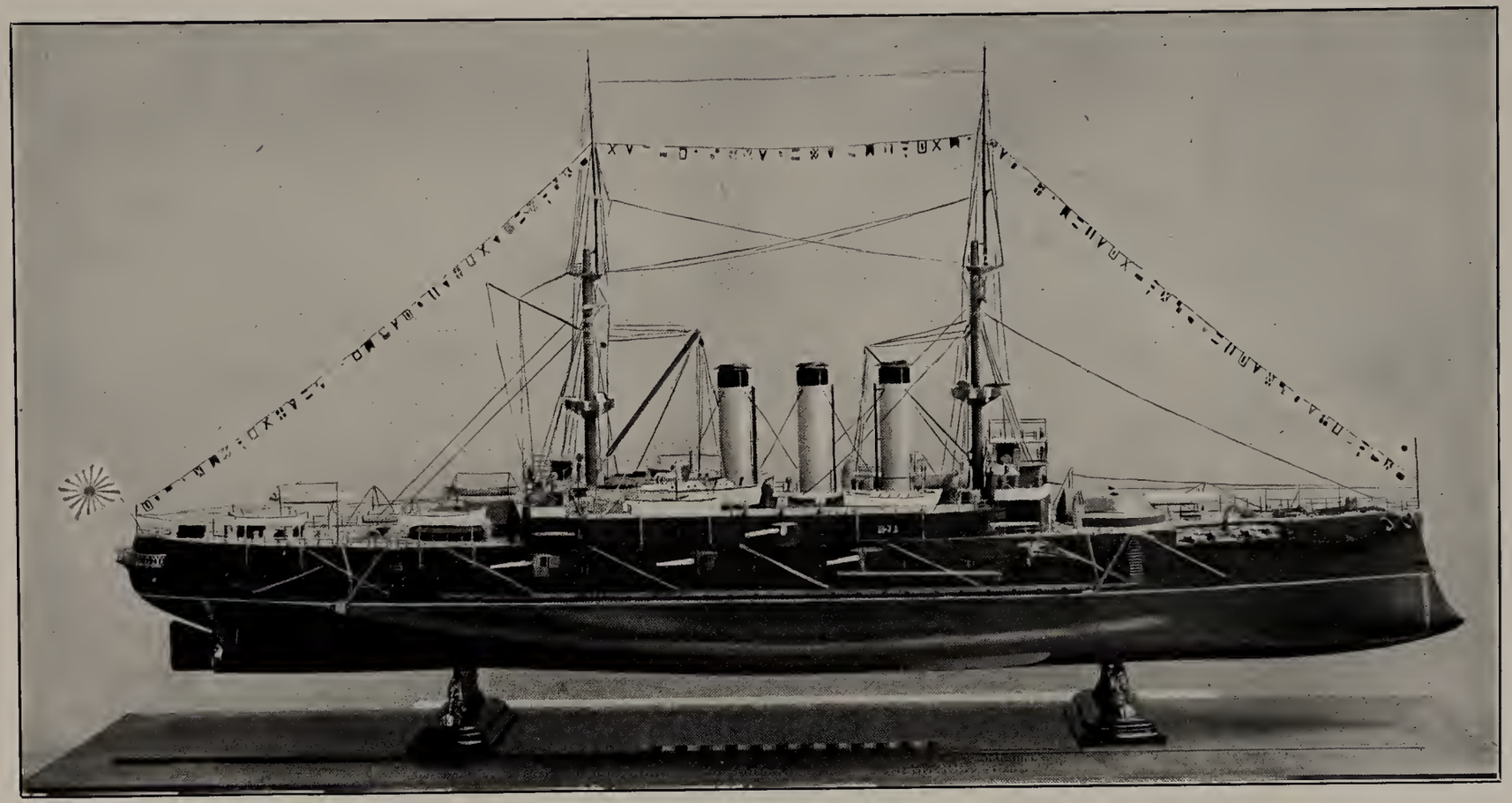
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

H.M.S. VICTORIA (1887)



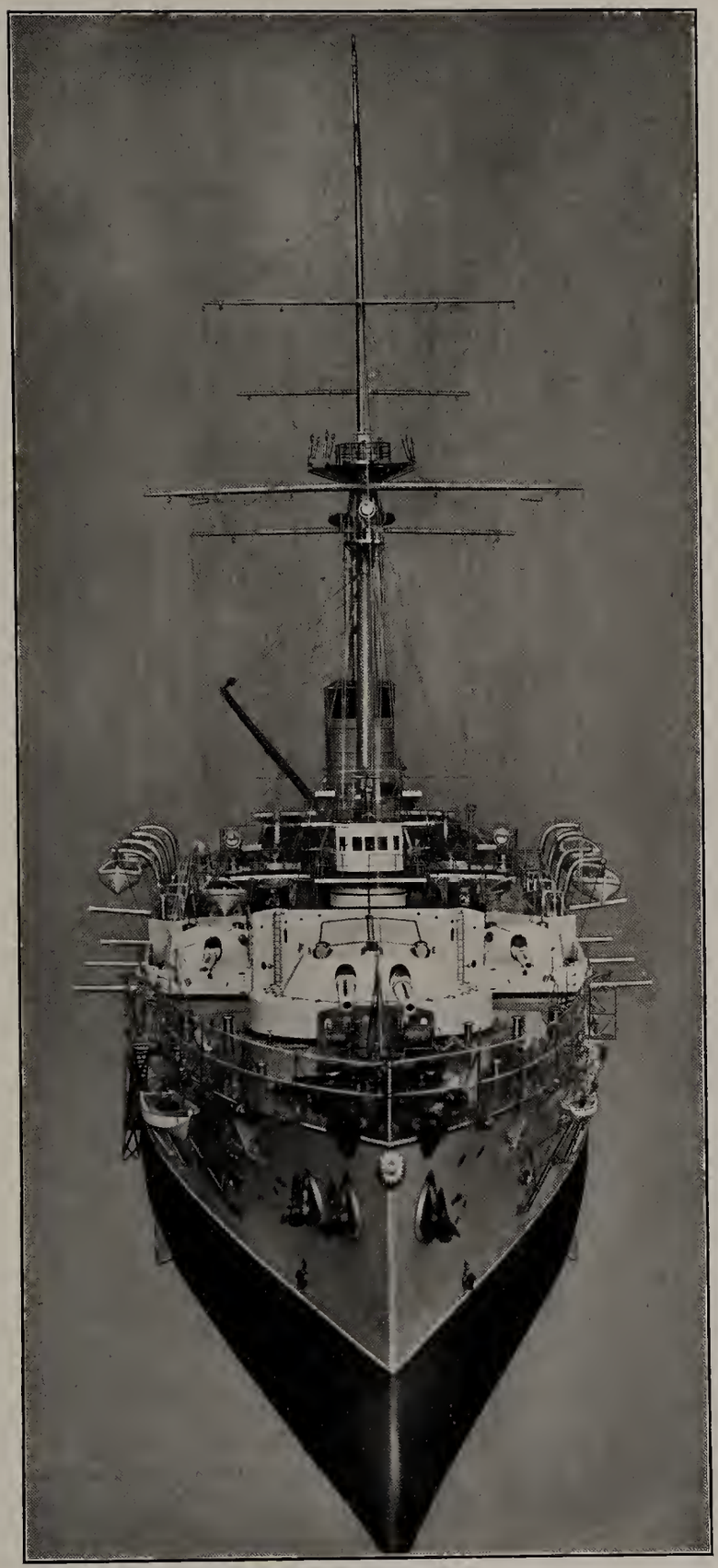
(Royal Naval College, Greenwich)

H.M.S. ROYAL SOVEREIGN (1891)



(Science Museum, South Kensington)

JAPANESE BATTLESHIP SHIKISHIMA (1897-9)



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

JAPANESE BATTLESHIP KASHIMA (1906)



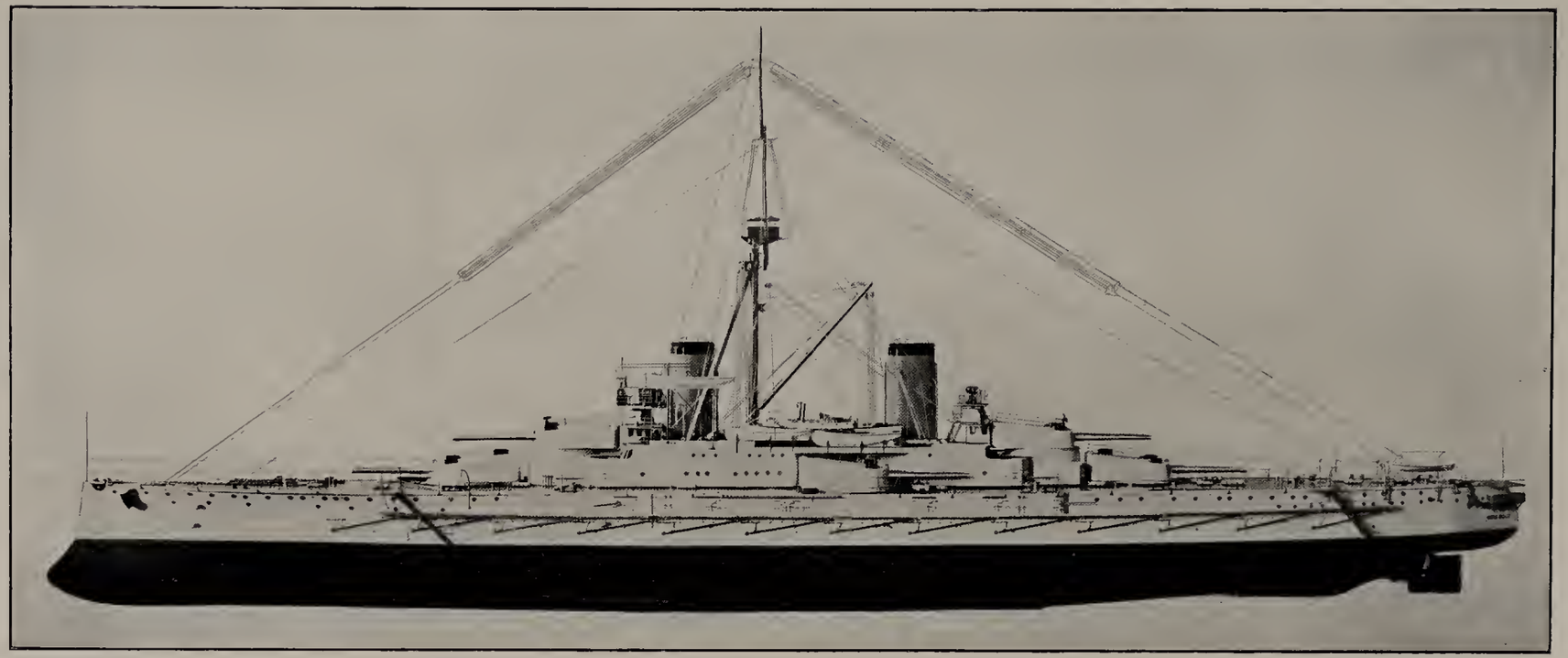
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

JAPANESE BATTLESHIP KASHIMA (1906)



(Royal Naval College, Greenwich)

JAPANESE BATTLESHIP AKI (1907)



(Royal Naval College, Greenwich)

BRAZILIAN BATTLESHIP MINAS GERAES (1910)



(Science Museum, South Kensington)

(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

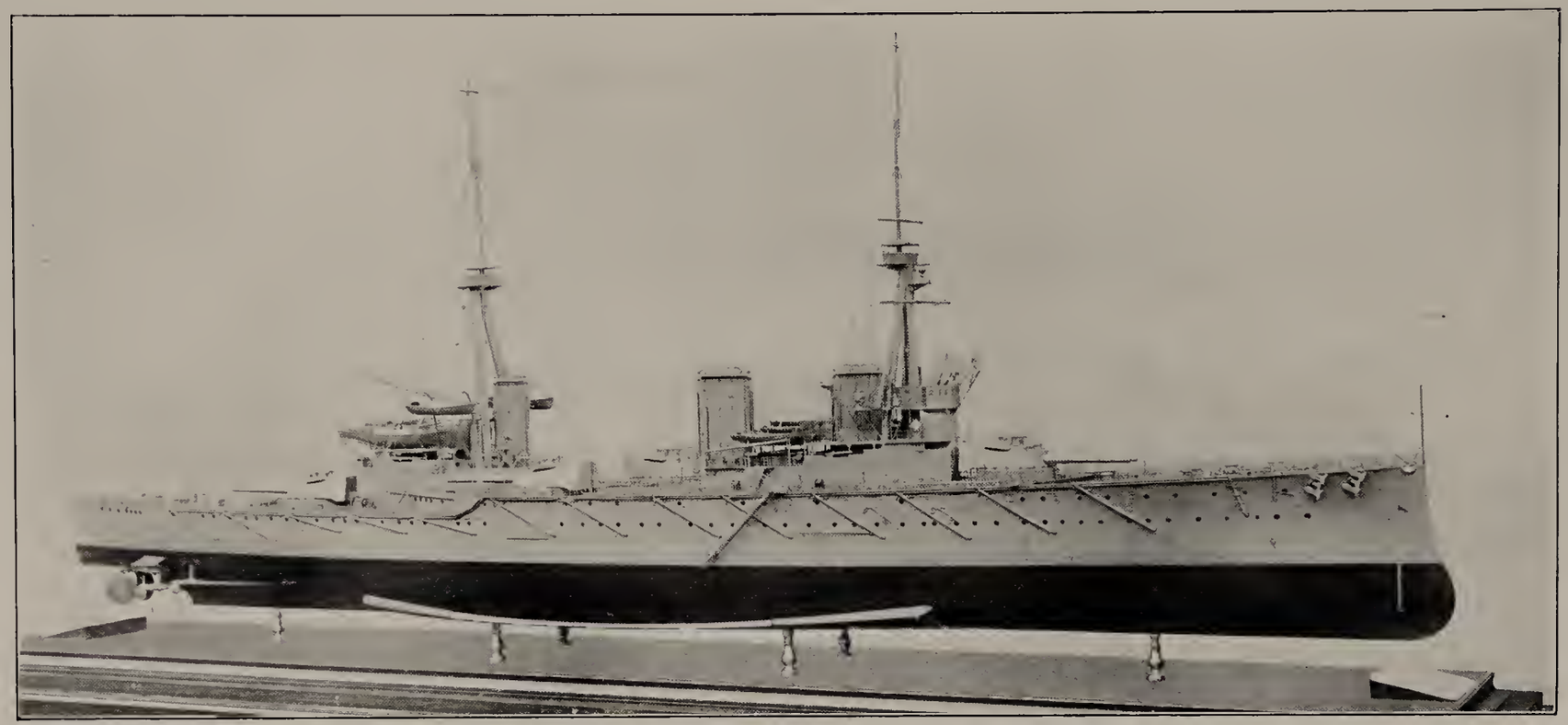
H.M.S. MONARCH (1912)



(Imperial War Museum)

(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

H.M.S. CANADA (1915)



(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

H.M.S. INDOMITABLE (1906)



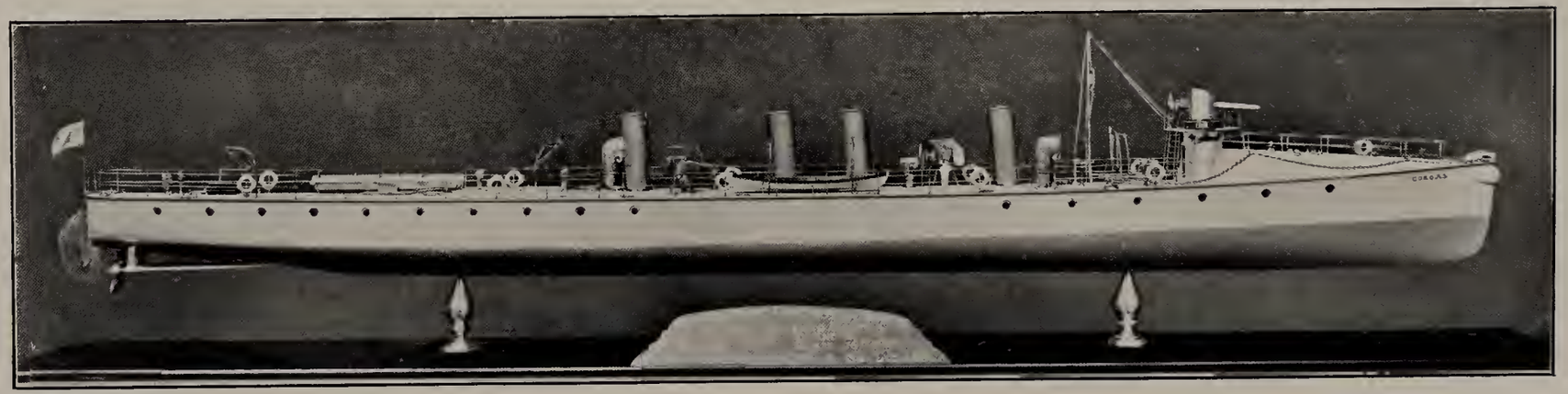
(Messrs Palmer's Shipbuilding and Iron Co. Ltd.)

H.M.S. QUEEN MARY (1913)



(Messrs John I. Thornycroft & Co. Ltd.)

H.M.T.B. LIGHTNING (1876)



(Messrs Yarrow & Co. Ltd.)

RUSSIAN DESTROYER SOKOL (1895)



(Science Museum, South Kensington)

(Messrs William Denny & Brothers Ltd.)

H.M.T.B. No. 17 (1907)



(Science Museum, South Kensington)

(Messrs Palmer's Shipbuilding and Iron Co. Ltd.)

H.M.S. VIKING (1909)



(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

H.M.S. GRASSHOPPER (1909)

PLATE 65

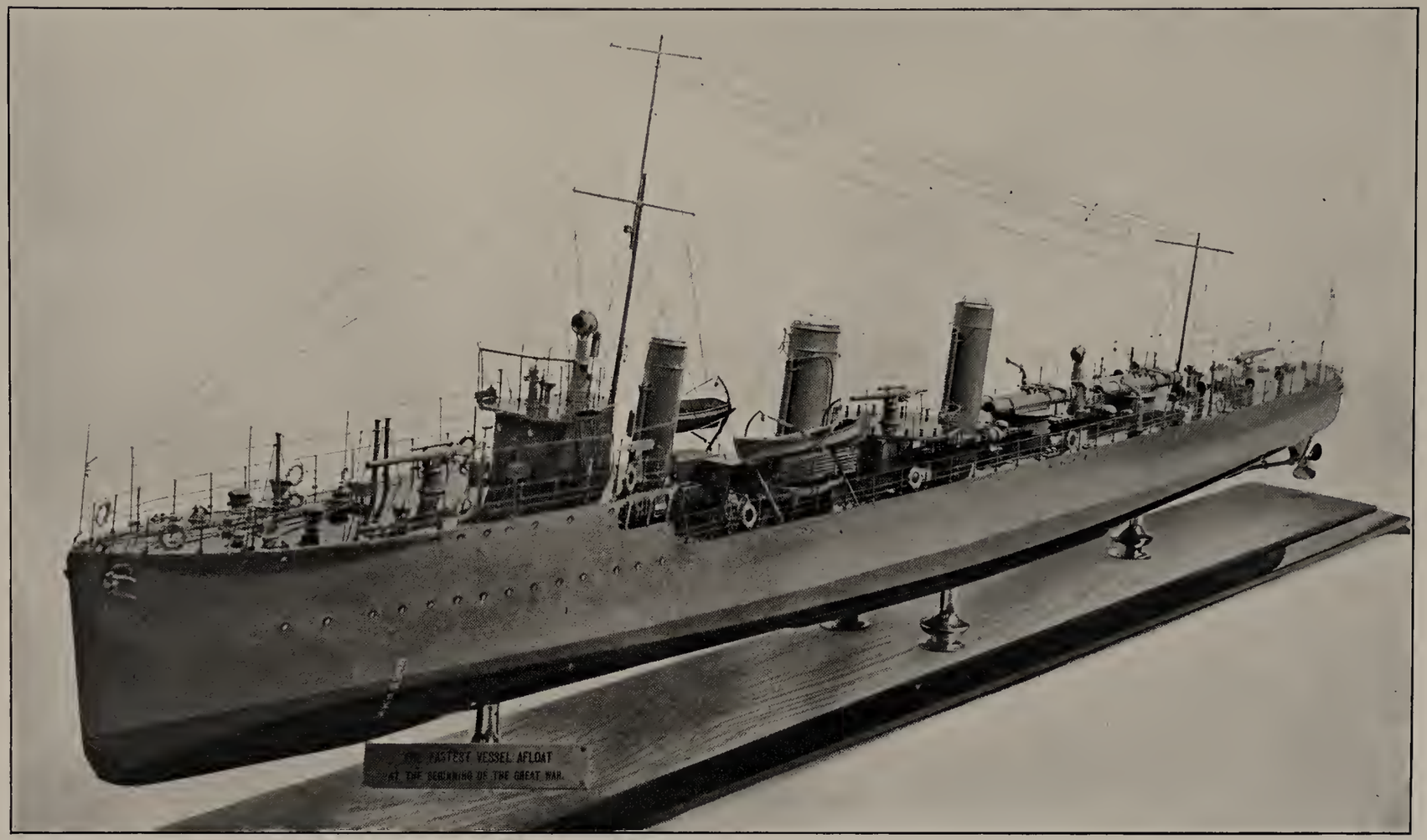
H.M.S. "BROKE" (1914)
(*Messrs J. Samuel White & Co. Ltd.*)





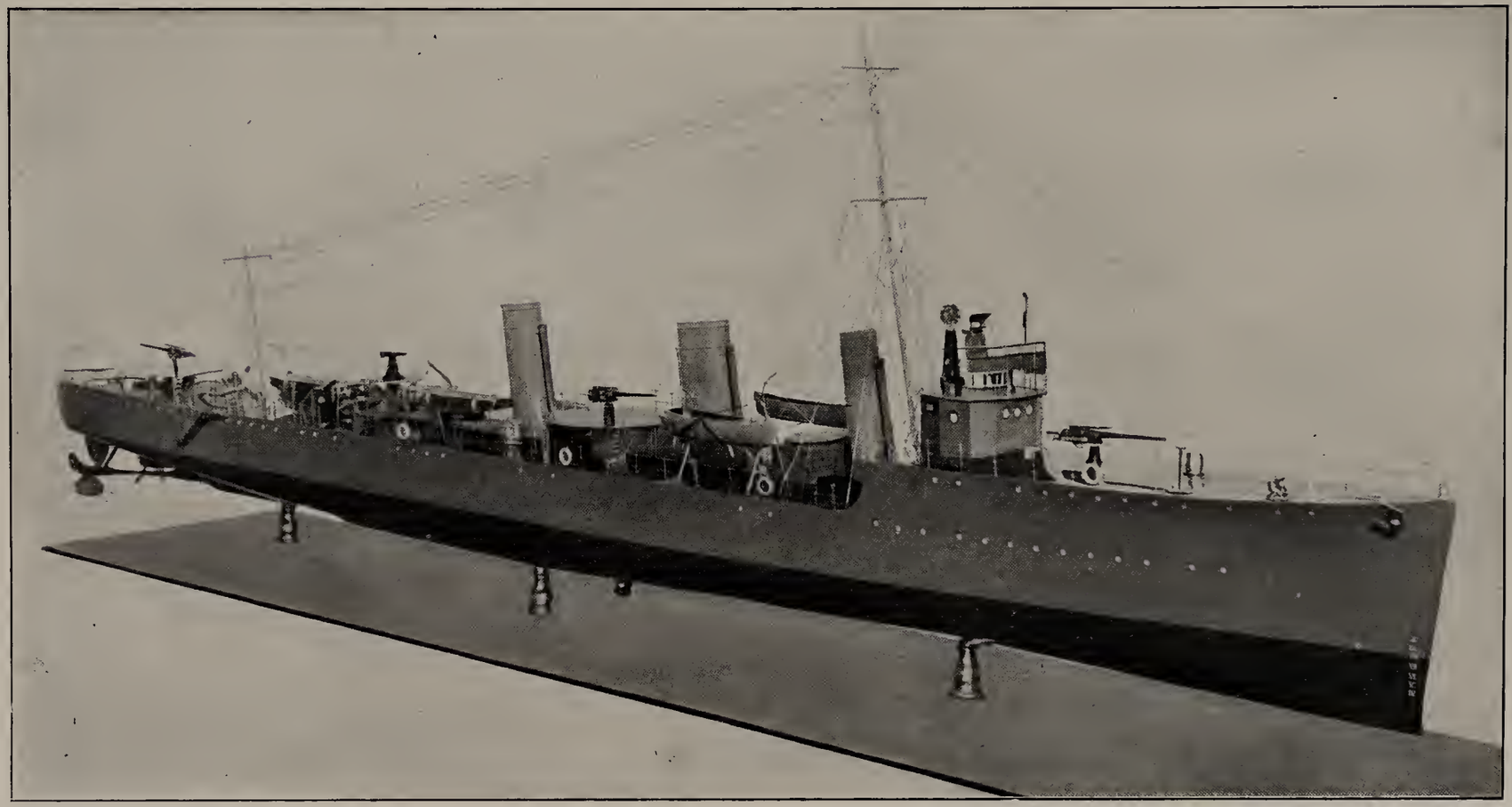
(Messrs Yarrow & Co. Ltd.)

H.M.S. FIREDRAKE (1915)



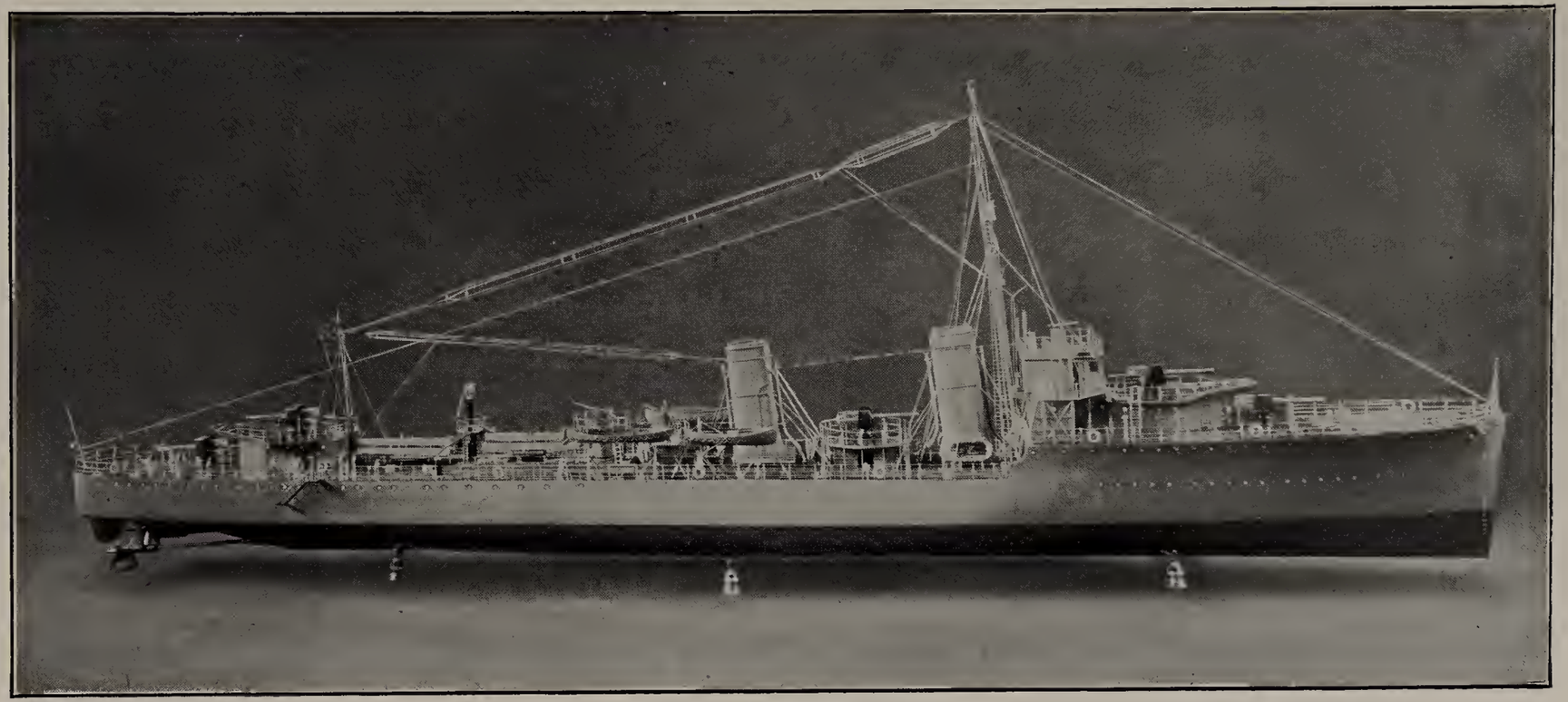
(Messrs John I. Thornycroft & Co. Ltd.)

H.M.S. MASTIFF (1915)



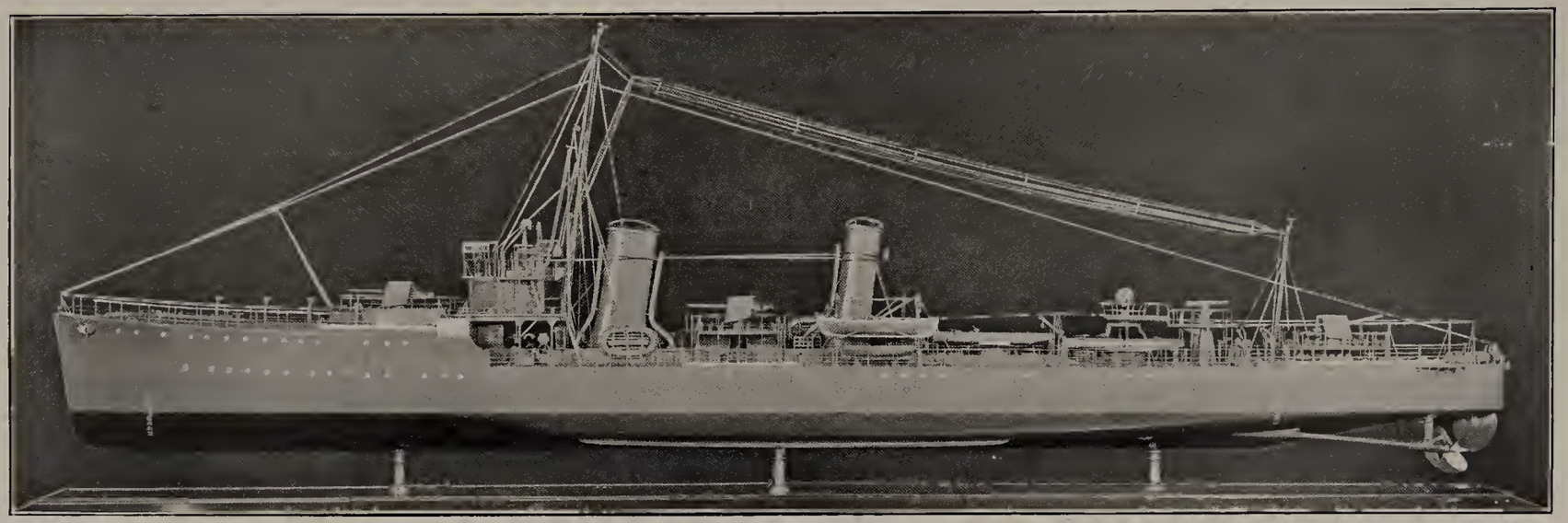
(Messrs John I. Thornycroft & Co. Ltd.)

H.M.S. TEAZER (1917)



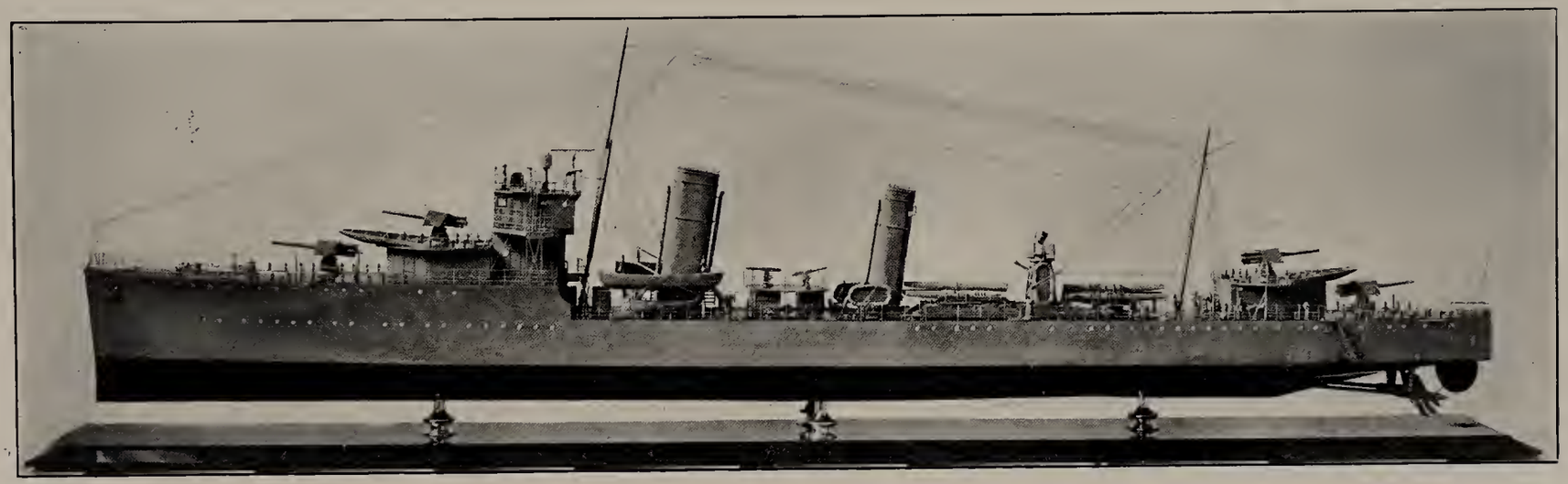
(Messrs John I. Thornycroft & Co. Ltd.)

H.M.S. SPENSER (1917)



(Messrs John I. Thornycroft & Co. Ltd.)

H.M.S. TOBAGO (1918)



(Messrs John I. Thornycroft & Co. Ltd.)

H.M.S. WISHART (1918)



(Messrs Cunard Steam Ship Co. Ltd.)

CARONIA (1905)



(Messrs Cunard Steam Ship Co. Ltd.)

ROYAL GEORGE



(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

EMPRESS OF RUSSIA (1913)



(Messrs Harland & Wolff Ltd.)

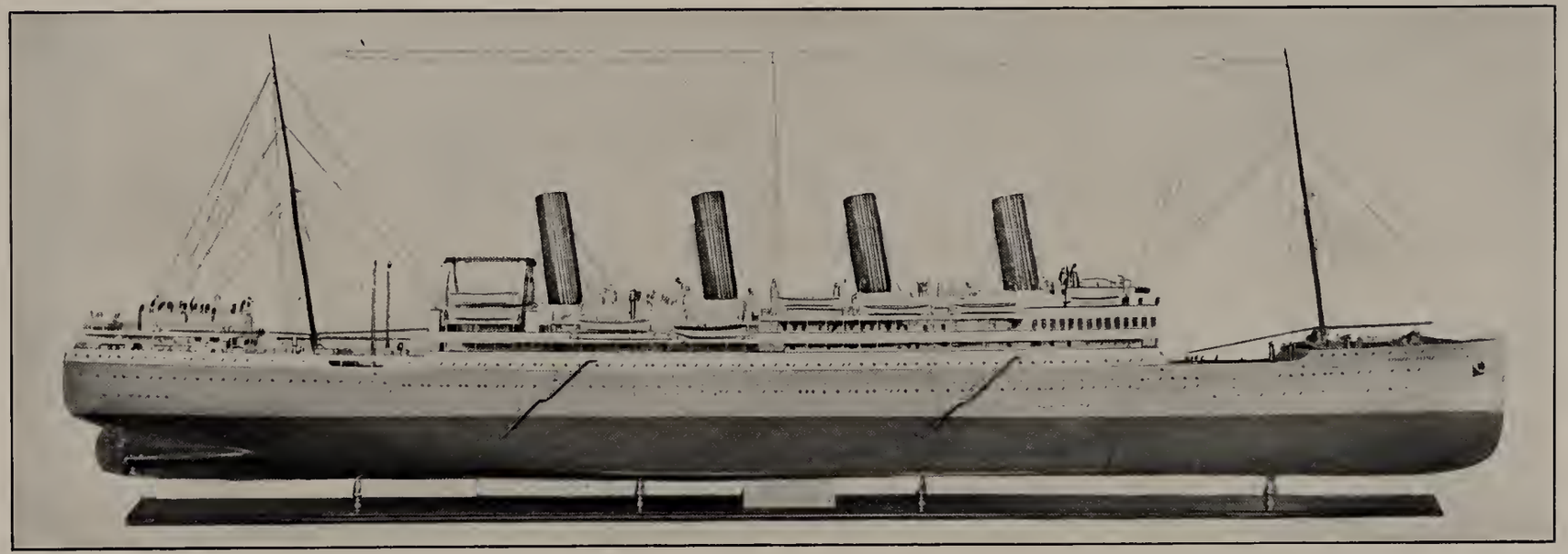
NARKUNDA (1920)



(Messrs William Beardmore & Co. Ltd.)

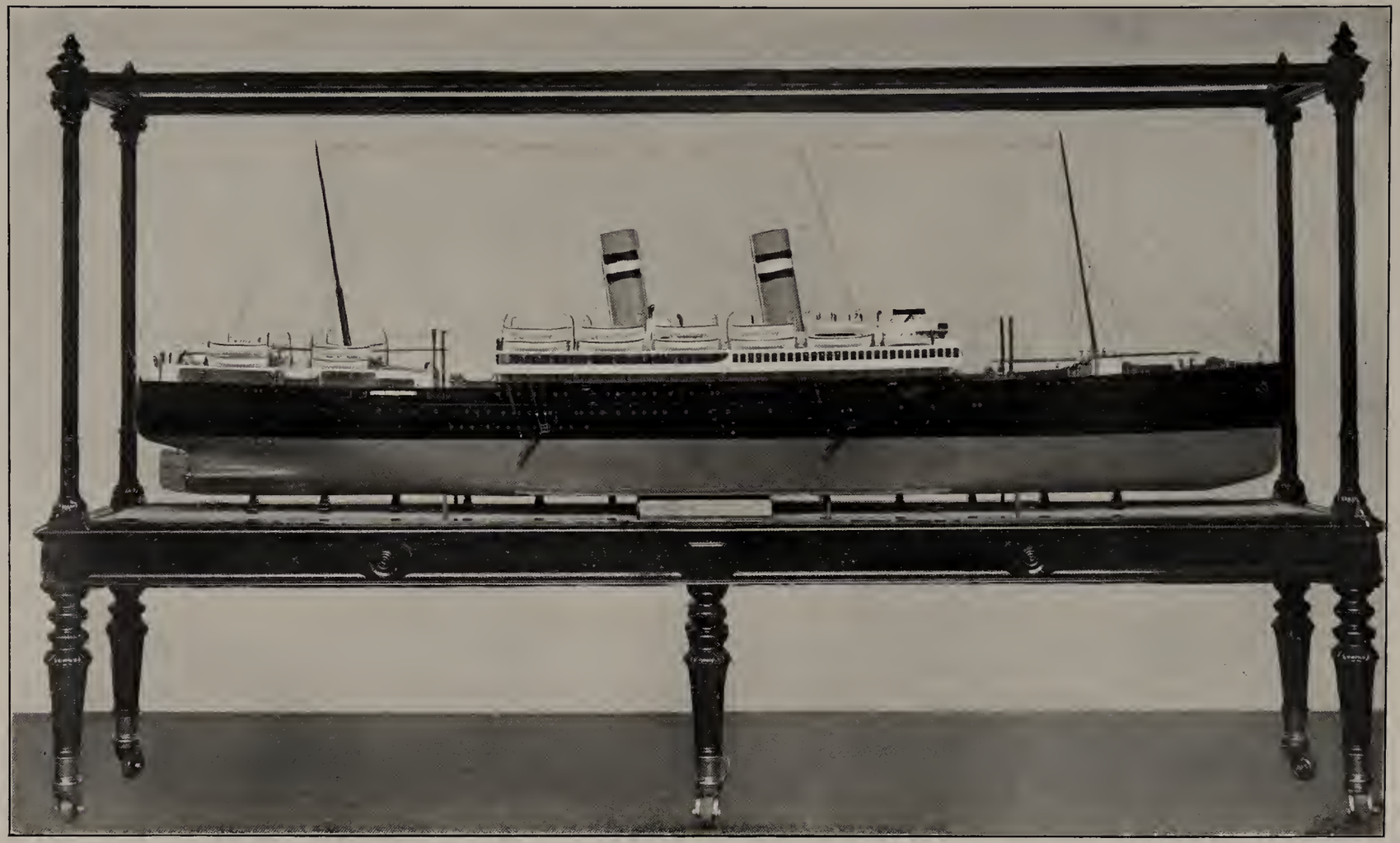
CAMERONIA (1920)

PLATE 77



(Messrs Union-Castle Mail Steamship Co. Ltd.)

ARUNDEL CASTLE (1921)



(Messrs Harland & Wolff Ltd.)

VOLENDAM (1922)



(Messrs William Beardmore & Co. Ltd.)

CONTE ROSSO (1922)



(Messrs William Beardmore & Co. Ltd.)

CONTE VERDE (1923)

PLATE 81

" ORAMA " (1924)

(*Messrs The Orient Line*)





(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

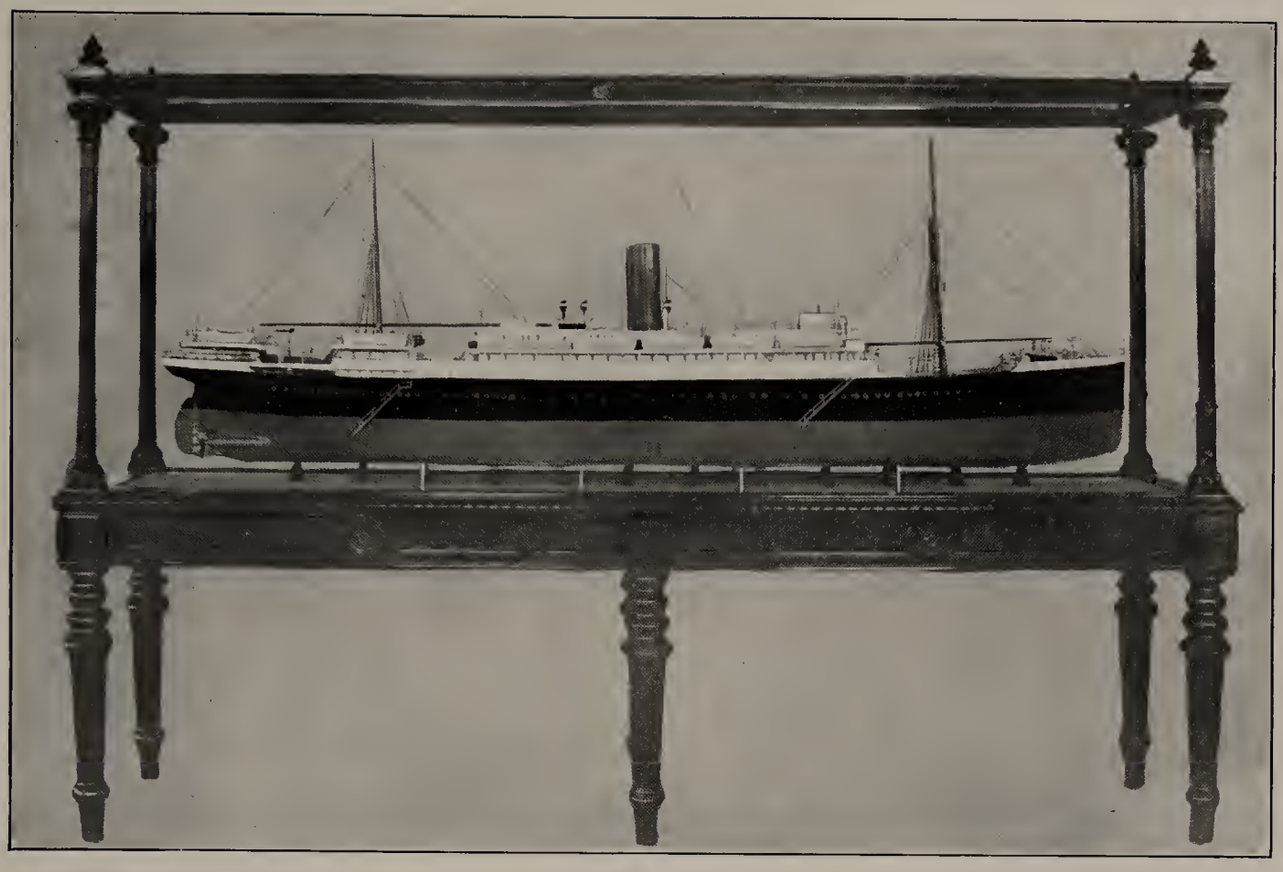
MONGOLIA (1923)



(Messrs Harland & Wolff Ltd.)

MOOLTAN (1923)

PLATE 84



(Messrs Harland & Wolff Ltd.)

ABOSSO (1924)

PLATE 85



(Messrs Harland & Wolff Ltd.)

THEMISTOCLES (1924)

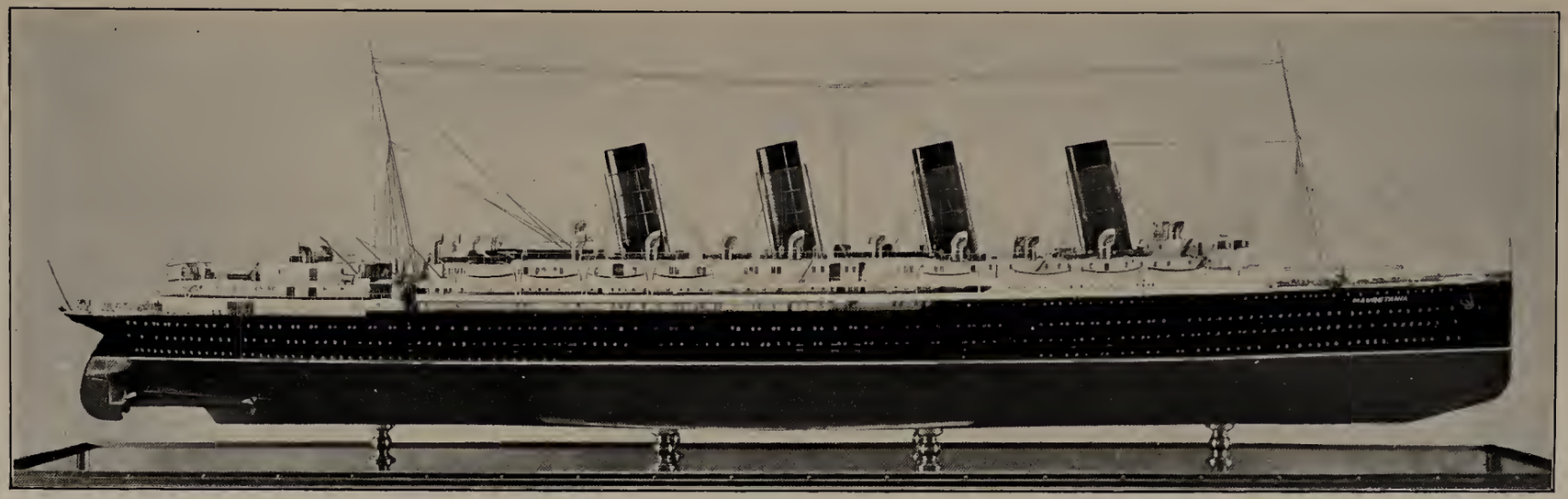
PLATE 86

" OHIO " (1923)

(Messrs Royal Mail Steam Packet Company)



PLATE 87



(Messrs Cunard Steam Ship Co. Ltd.)

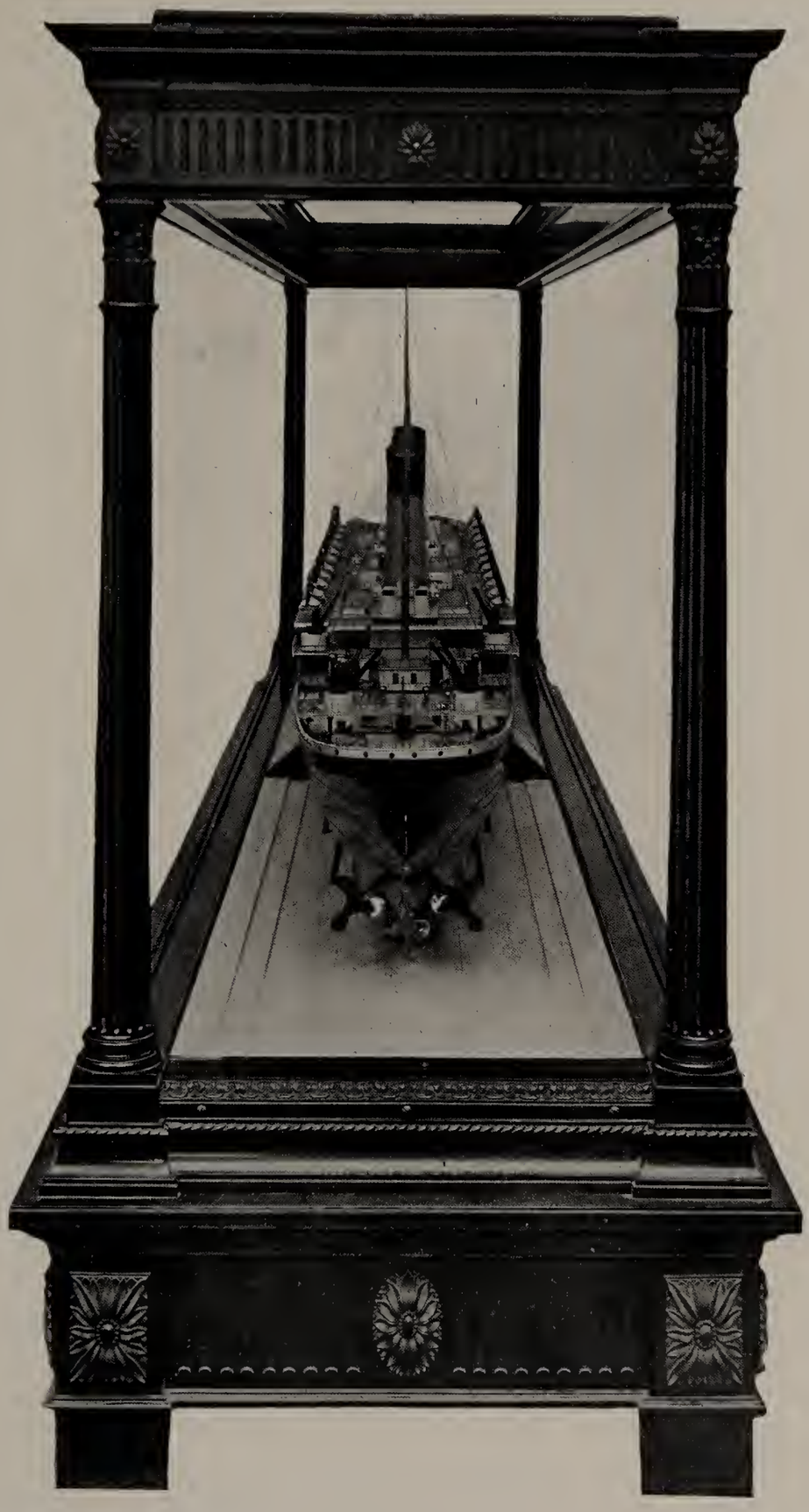
MAURETANIA (1908)

PLATE 88



(Messrs The White Star Line)

OLYMPIC (1911)



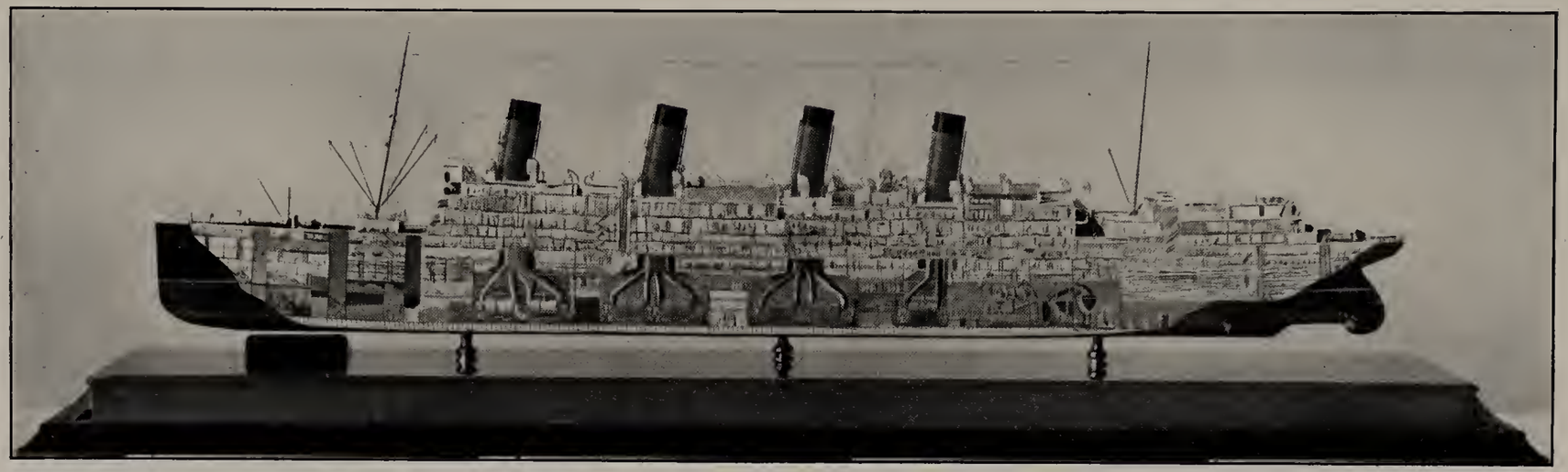
(Messrs The White Star Line)

OLYMPIC (1911)



(Messrs Cunard Steam Ship Co. Ltd.)

AQUITANIA (1914)



(Messrs Cunard Steam Ship Co. Ltd.)

AQUITANIA (1914)



(Messrs Cunard Steam Ship Co. Ltd.)

BERENGARIA (1912)



(Messrs The White Star Line)

MAJESTIC (1921)



(Messrs The White Star Line)

HOMERIC (1922)



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

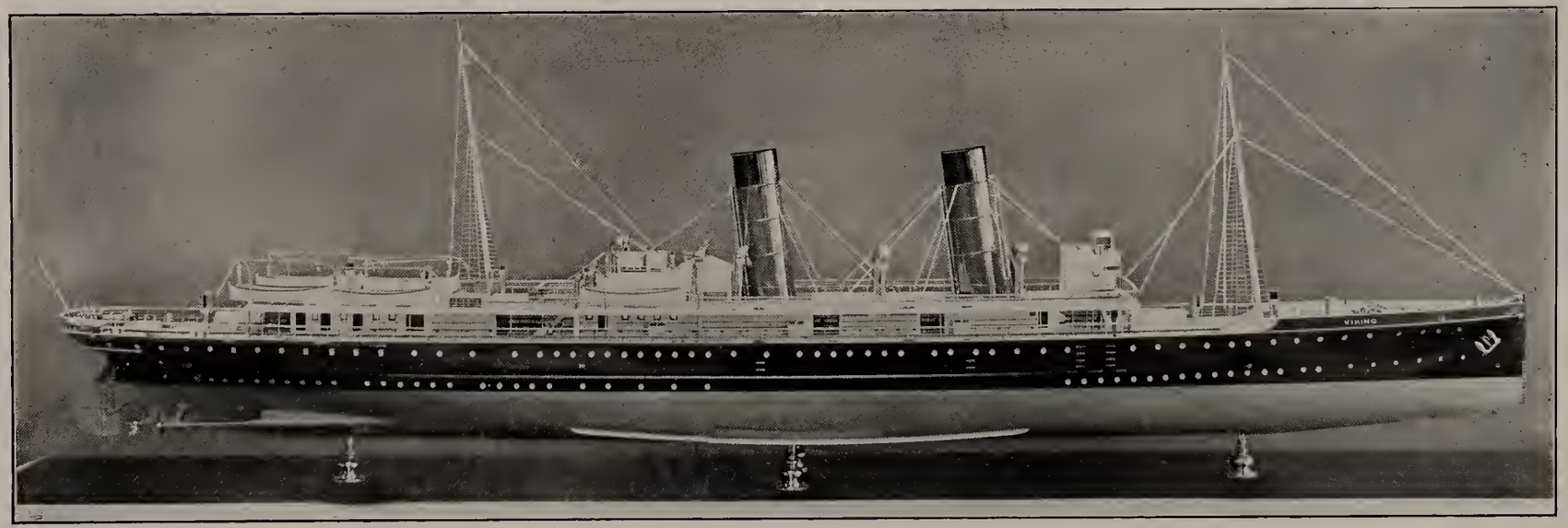
THE 60,000-TON FLOATING DOCK FOR SOUTHAMPTON LINERS (1924)



(Science Museum, South Kensington)

(Messrs William Denny & Brothers Ltd.)

QUEEN ALEXANDRA (1902)



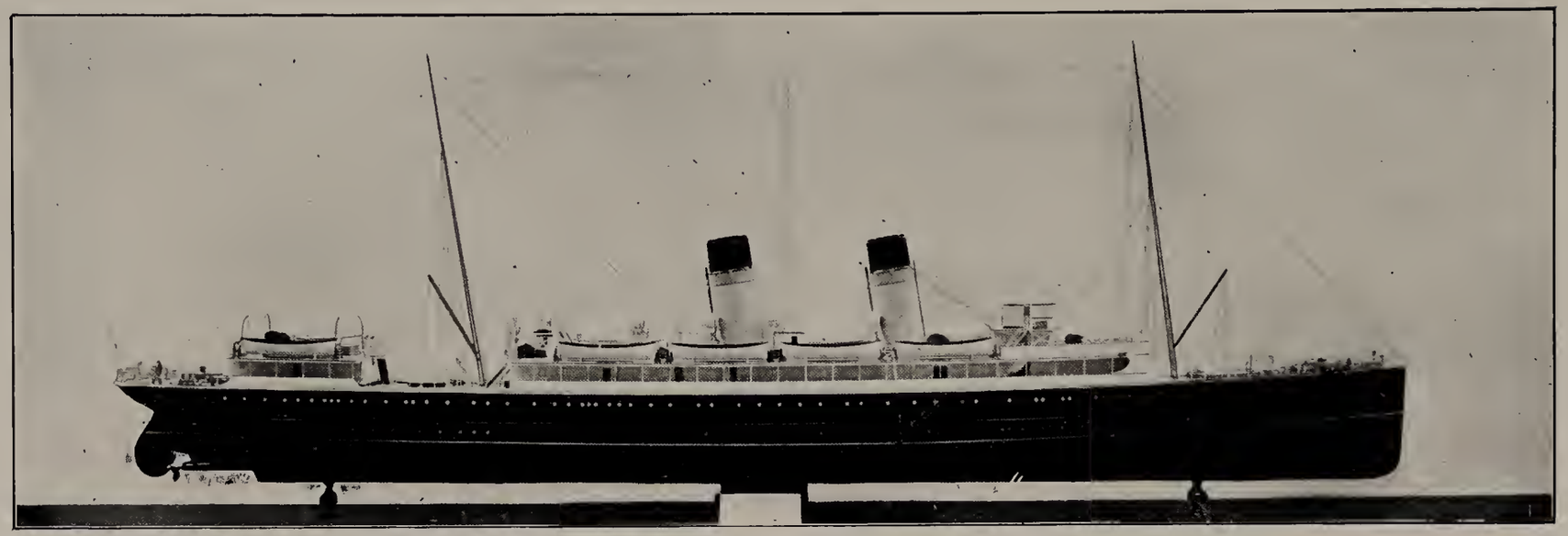
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

VIKING (1905)



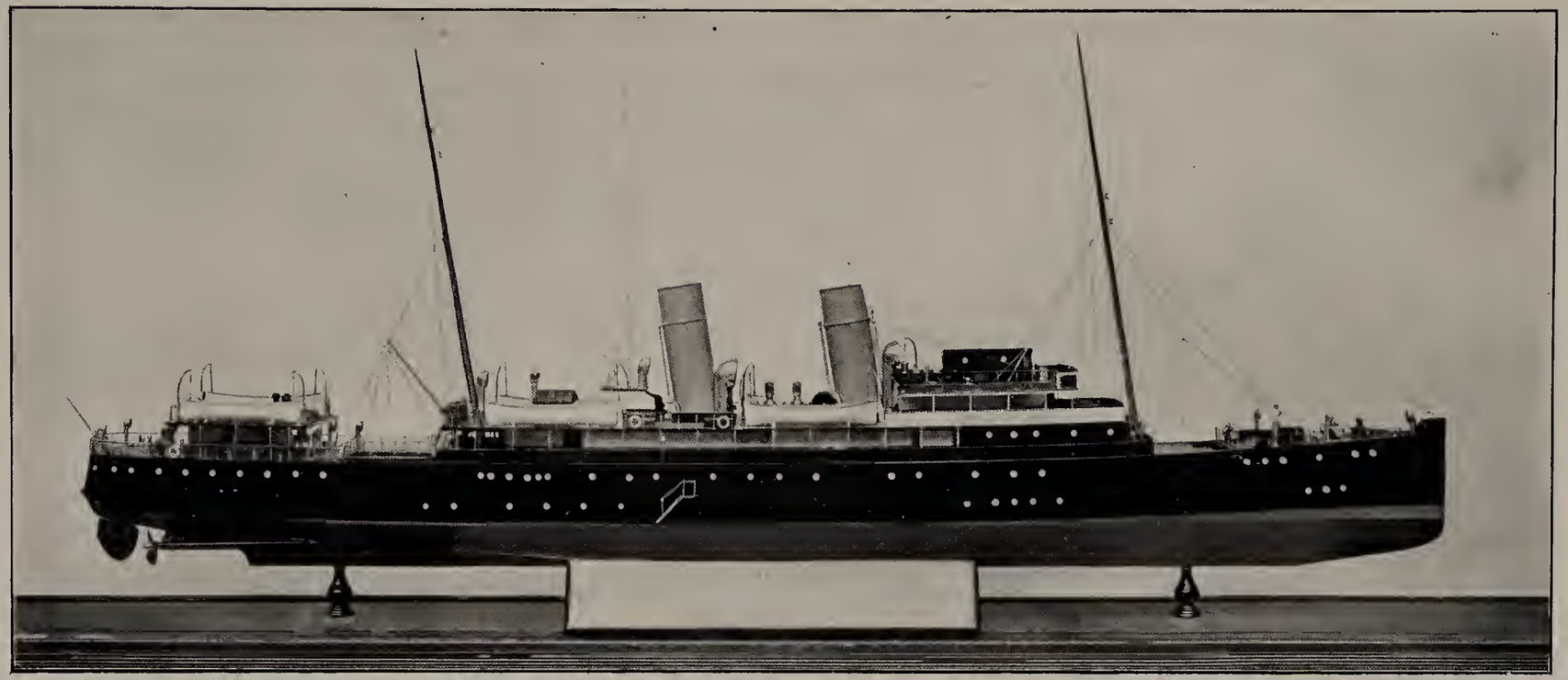
(Messrs The Southern Railway)

QUEEN (SUNK 1916)



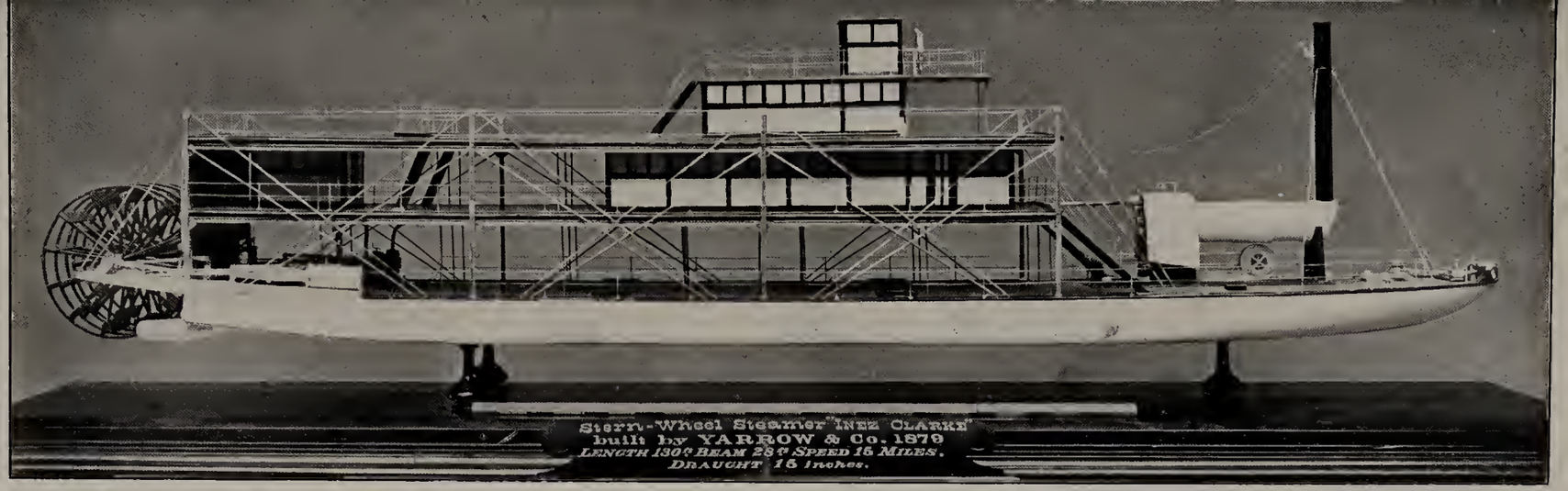
(Messrs London, Midland and Scottish Railway Company)

ANGLIA (1920)



(Messrs The Southern Railway)

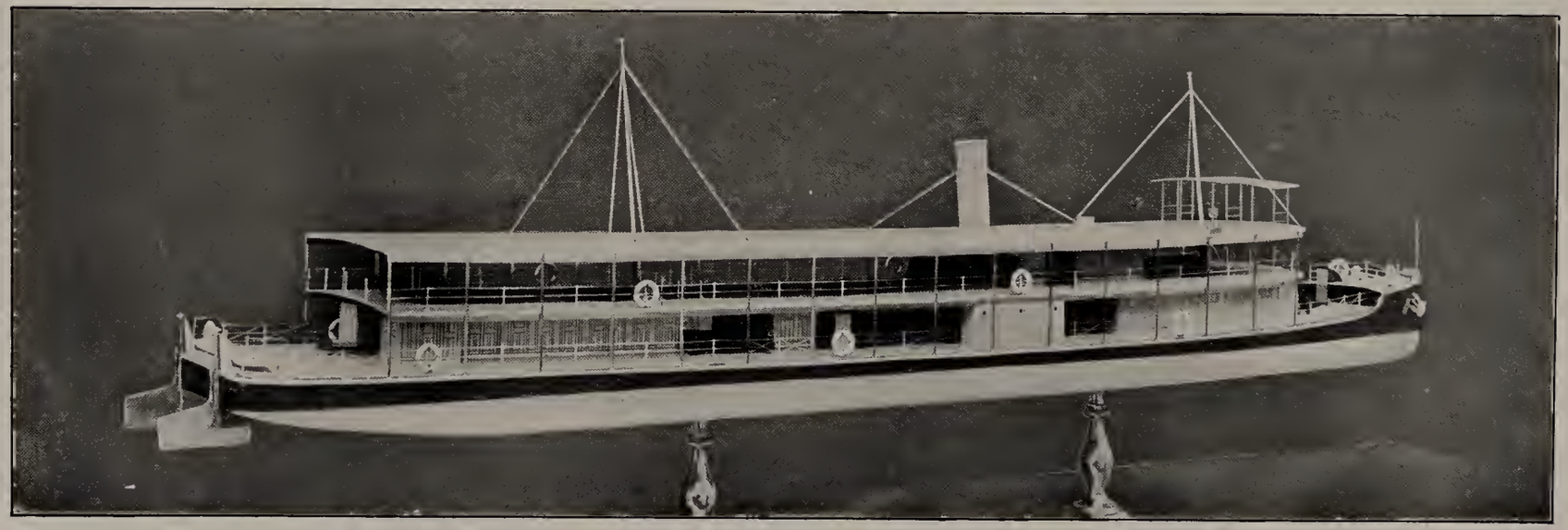
LORINA (1918)



(Science Museum, South Kensington)

INEZ CLARKE (1879)

PLATE 102



(Messrs Yarrow & Co. Ltd.)

SHALLOW DRAUGHT STEAMER

PLATE 103



(Messrs J. Samuel White & Co. Ltd.)

VALIANT

PLATE 104



(Messrs John I. Thornycroft & Co. Ltd.)

EGYPT (1907)



(Imperial War Museum)

(Messrs Yarrow & Co. Ltd.)

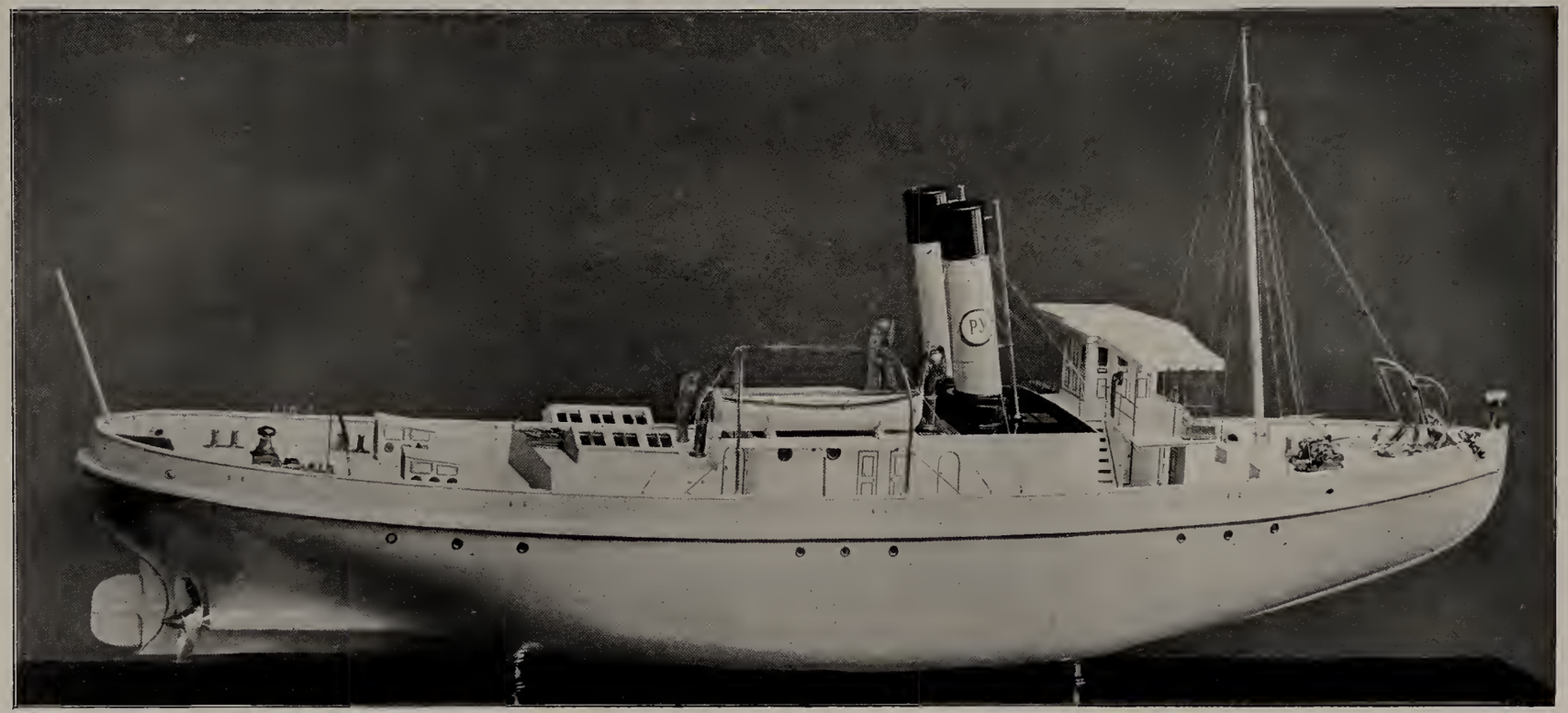
TIGRIS GUNBOAT (1917)



(Science Museum, South Kensington)

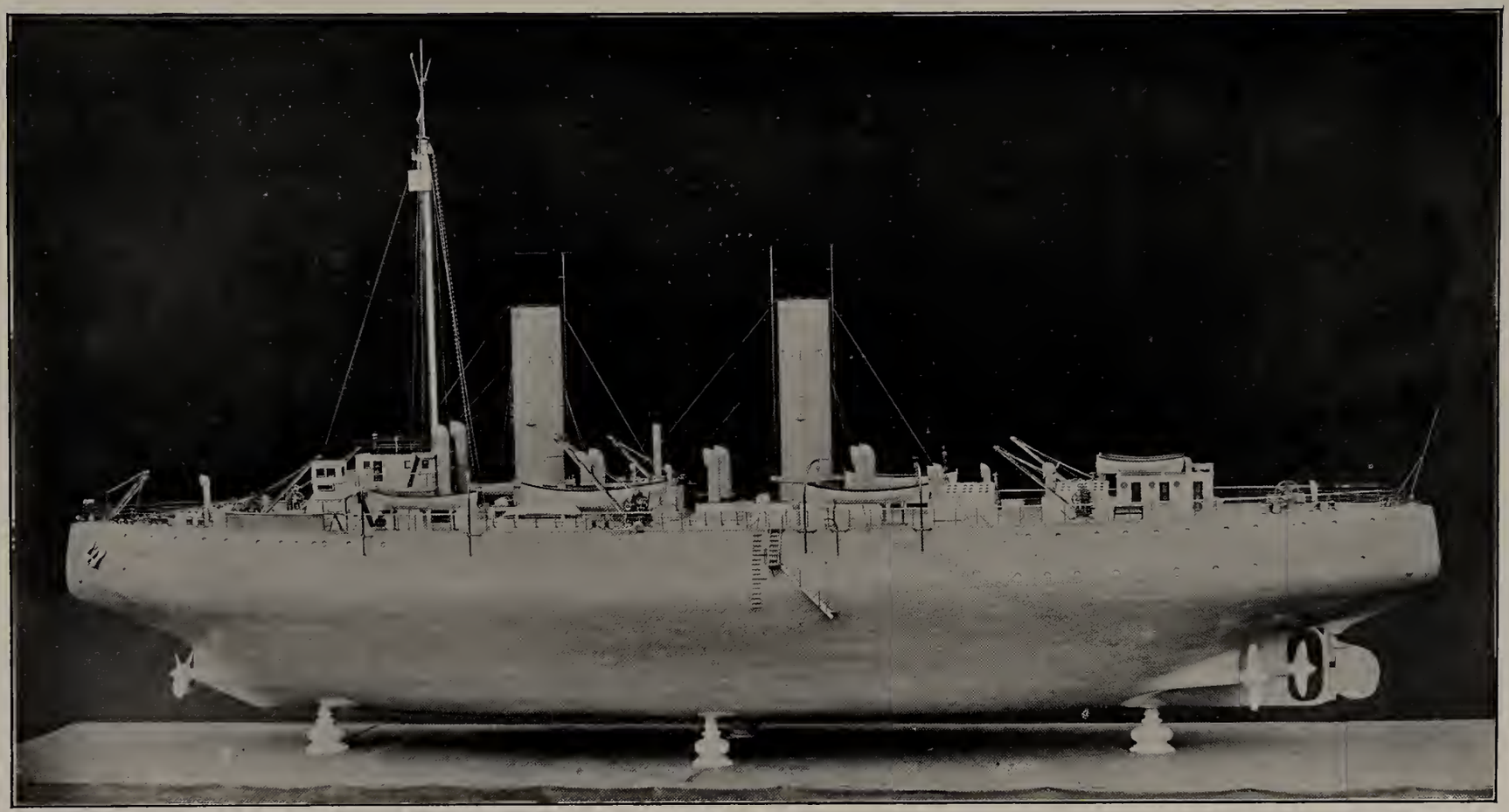
(Messrs Barclay, Curle & Co. Ltd.)

DROMEDARY (1894)



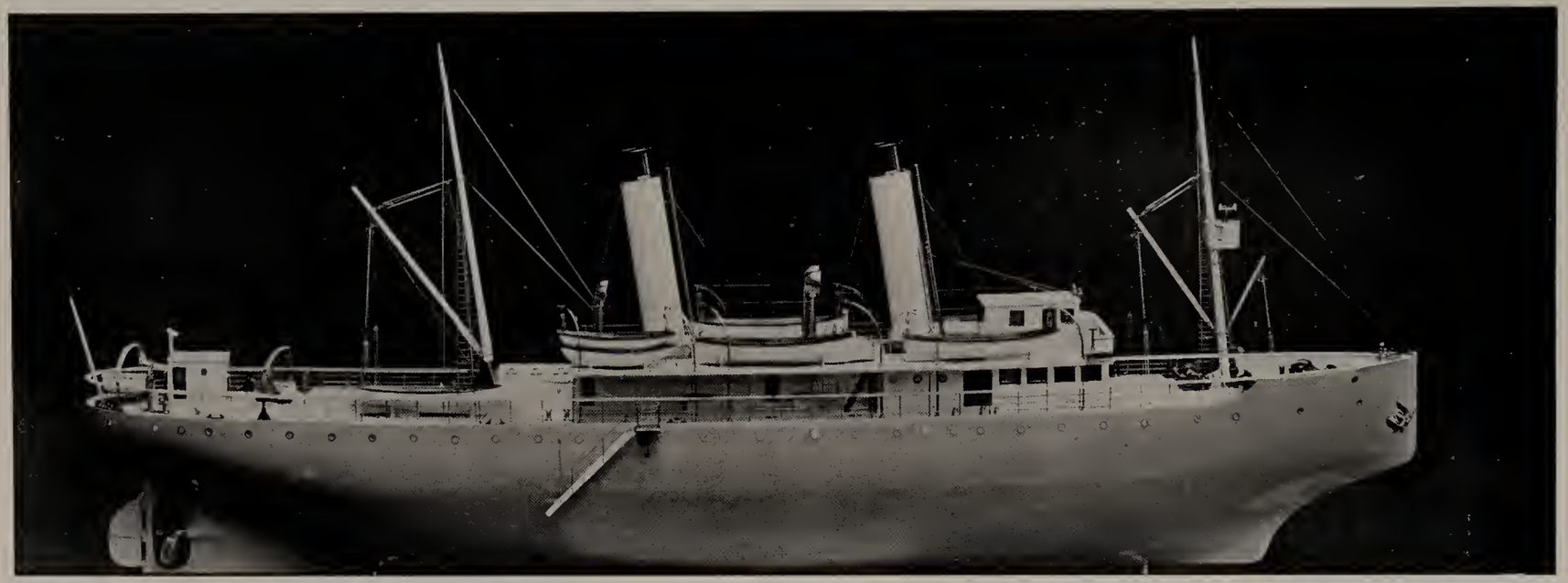
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

SARATOVSKI LEDOKOL



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

ERMACK (1898)



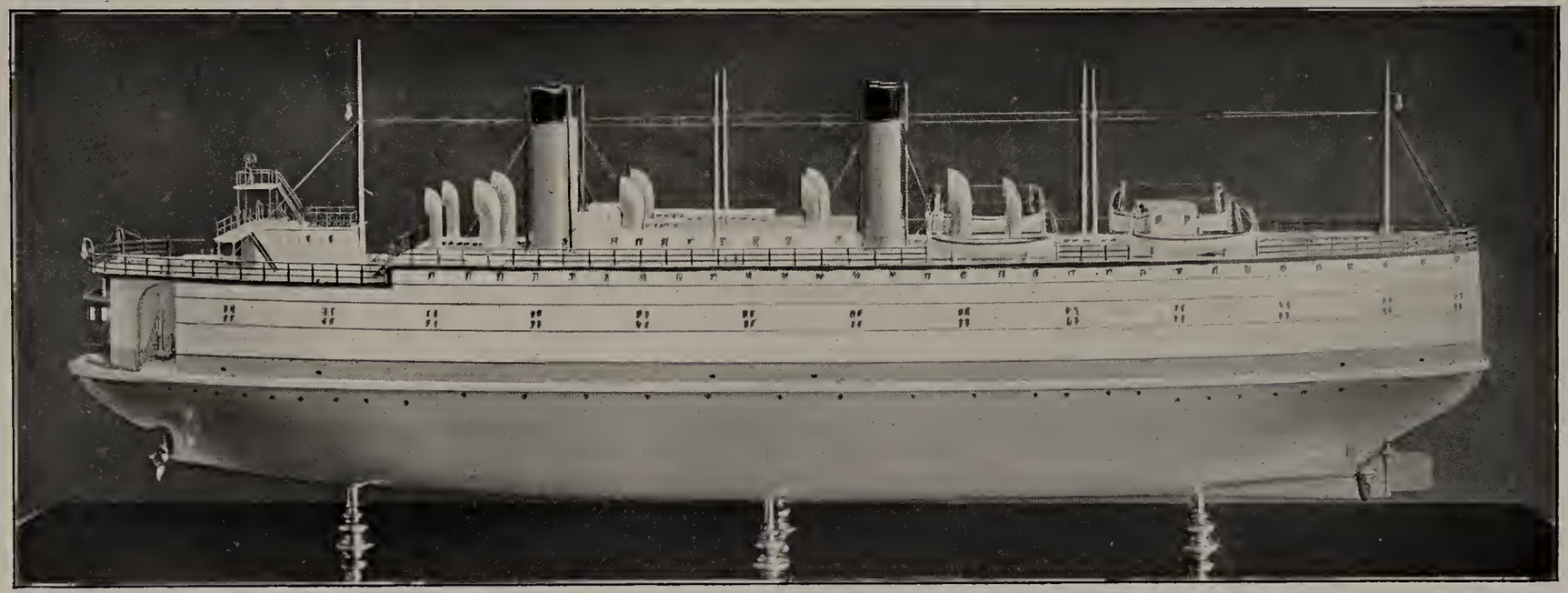
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

ANGARA (1899)



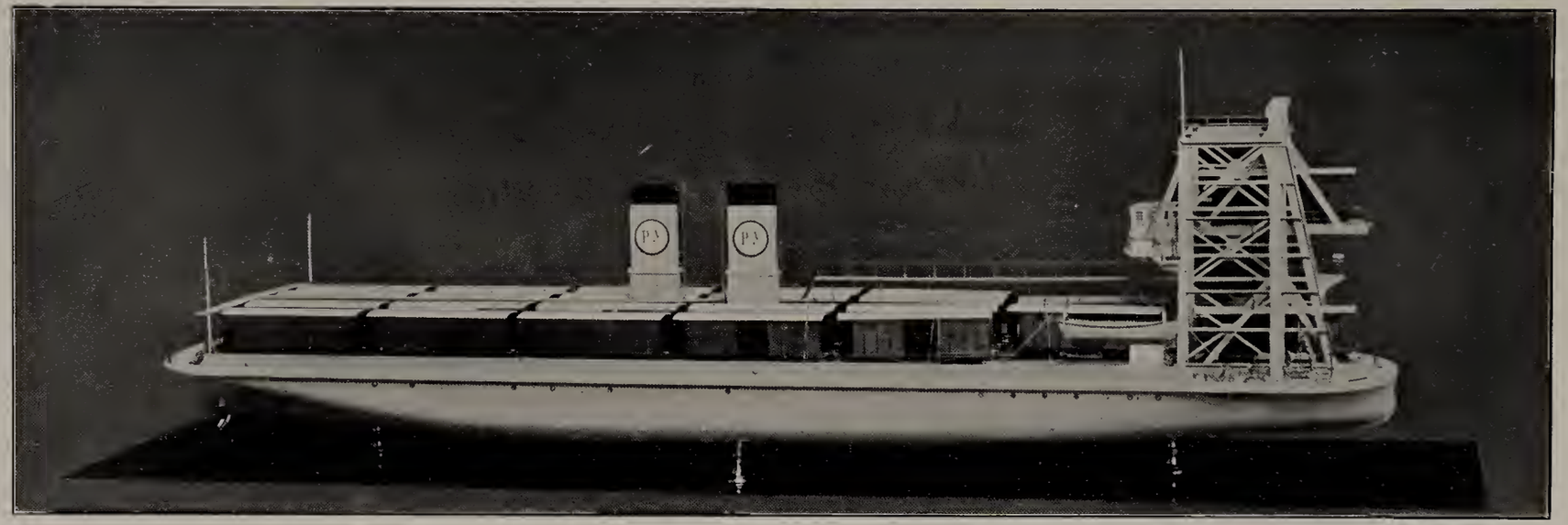
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

LEDOKOL (1899)



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

BAIKAL (1898)



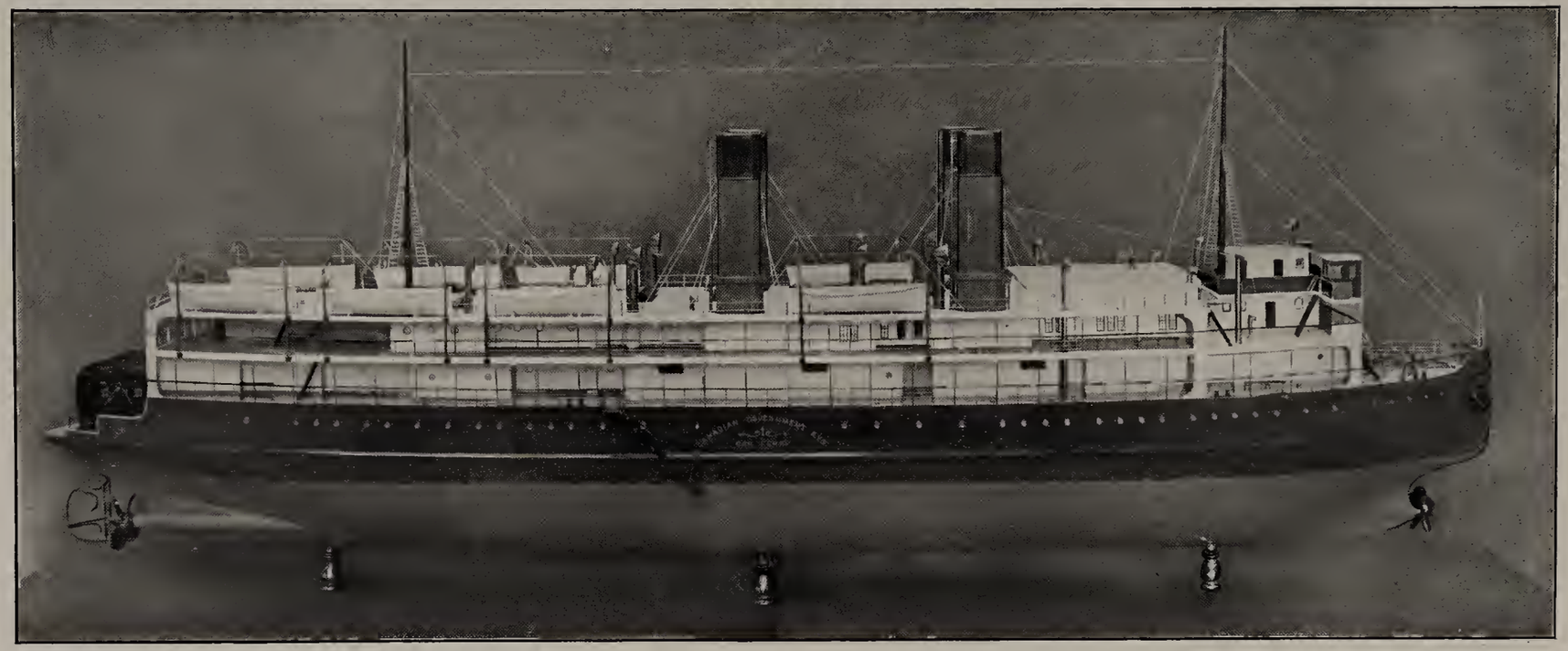
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

SARALOVSKAIA PEREPRAVA



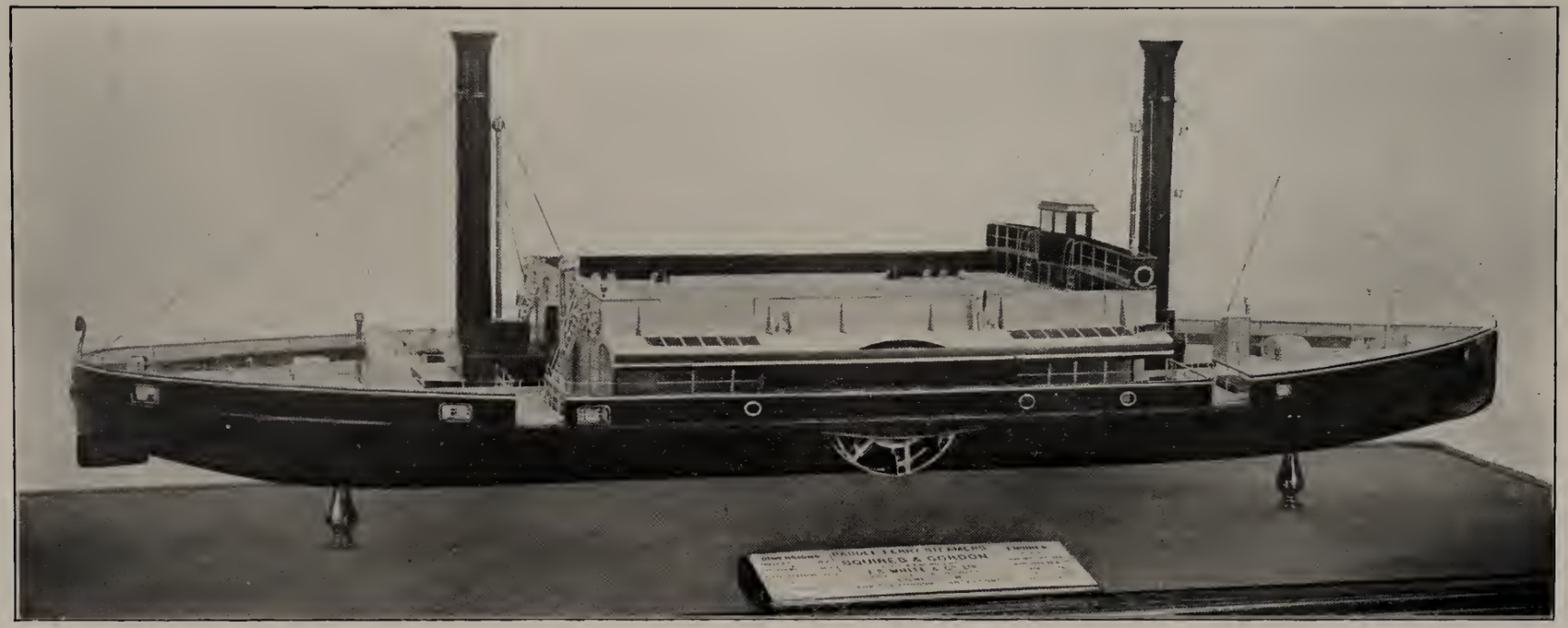
(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

SCOTIA (1901)



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

PRINCE EDWARD ISLAND (1915)



(Messrs J. Samuel White & Co. Ltd.)

PADDLE FERRY STEAMER SQUIRES



(Imperial War Museum)

H.M. TRAWLER WILLIAM LEECH (1918)



(Messrs Smith's Dock Company)

H.M. TRAWLER DANIEL HENLEY (1918)



(Messrs Smith's Dock Company)

ARCTIC WHALE (1915)



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

SECTIONAL MODEL OF TANKER TIFLIS (1900)



(Messrs Sir W. G. Armstrong, Whitworth & Co. Ltd.)

STROMBOS (1900)



(Science Museum, South Kensington)

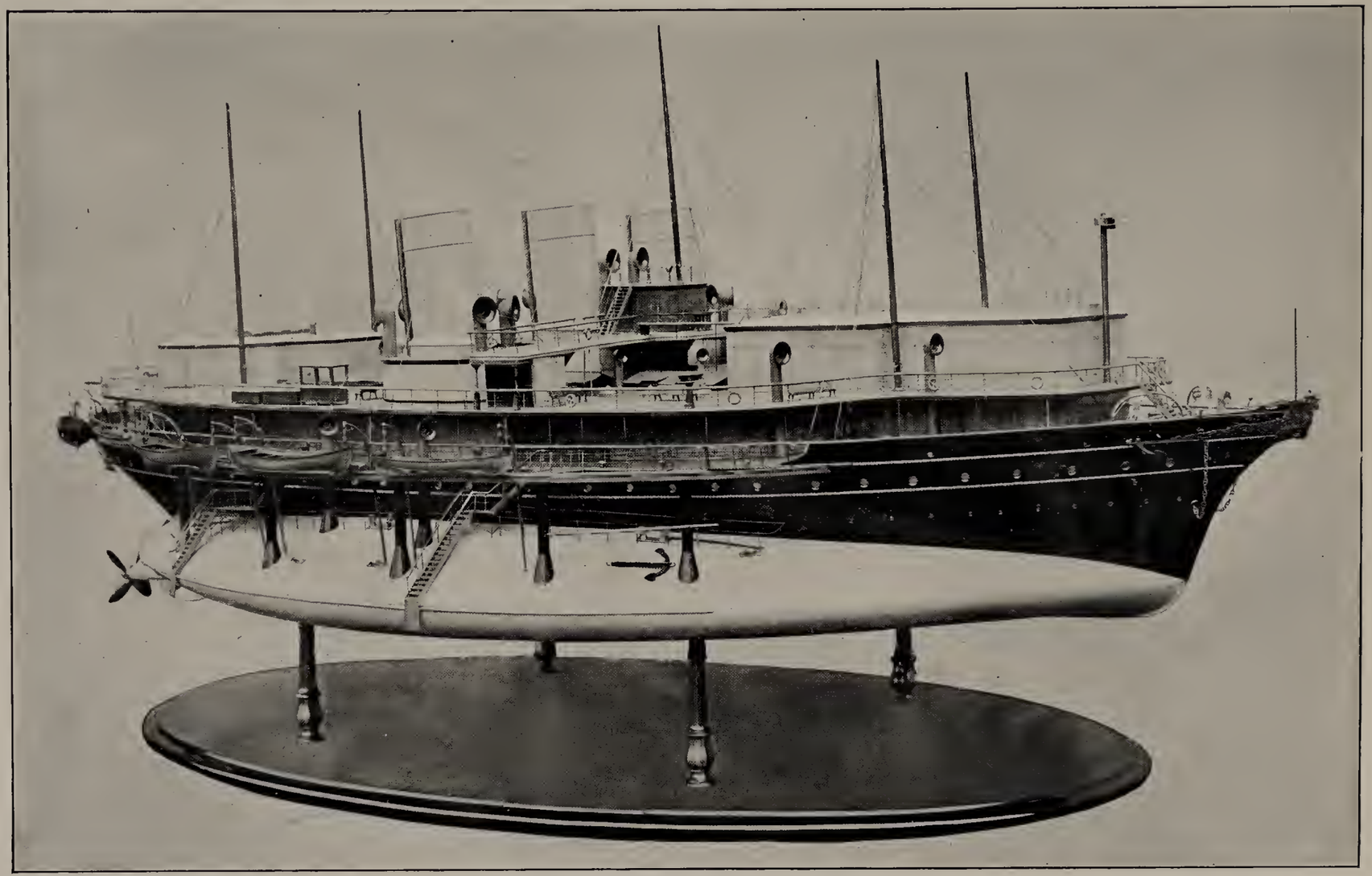
(Messrs The Shell Transport and Trading Co. Ltd.)

SILVERLIP (1903)



(Messrs C. L. Watson & Co.)

S.Y. HEBE (1869)



(Messrs The Fairfield Shipbuilding and Engineering Co. Ltd.)

RUSSIAN IMPERIAL S.Y. LIVADIA (1880)

PLATE 124



(Messrs G. L. Watson & Co.)

S.Y. MARIA (1896)

PLATE 125



(Messrs G. L. Watson & Co.)

S.Y. MARGARITA (1898)



(Messrs G. L. Watson & Co.)

S.Y. KATOOMBA I (1898)

PLATE 127

S.Y. " THALASSA " (1924)
(Messrs G. L. Watson & Co.)



PLATE 128

S.Y. " THALASSA " (1924)
(*Messrs G. L. Watson & Co.*)



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